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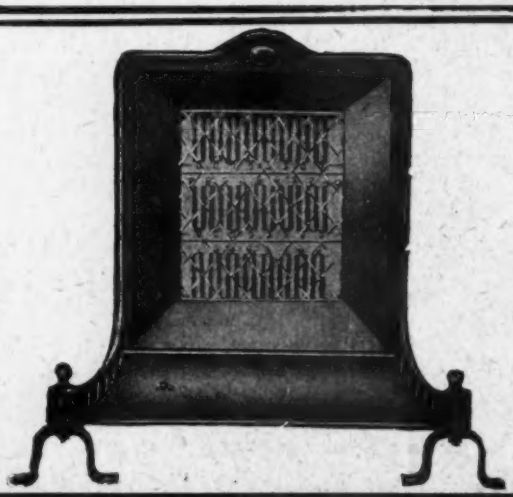

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THE STRIKE AND ITS LESSONS.

OUR readers are too well acquainted with the outbreak, progress, and conclusion of the recent strike of railwaymen to require any account of its history at our hands; but so notable and significant an event cannot be passed over in silence, without an attempt to turn it to profit by extracting from it some useful lessons for the future.

Of the merits of the strike we have little to say; that it was essentially a great mistake is agreed on all hands, except among those responsible for its initiation—and probably they also in their innermost consciousness are well aware of the fact, which was sufficiently attested by the strenuous efforts of their Trade-Union colleagues to extricate them from the quandary in which they found themselves. The fundamental weakness of their position was the lack of an adequate reason for striking at this time, on a question which could not become acute for at least six months—if then. They built upon a quicksand, and the inevitable failure of their strategy was a foregone conclusion, while the tactical error of the lightning strike under such circumstances alienated public opinion from the very first. On the other hand, the dilatory methods of Government departments cannot be held guiltless in the matter, and the two aspects of the conflict have been ably summarised by Mr. J. R. Clynes, M.P., himself a prominent member of the Labour Party, who, in an interview, said:—"I did not approve of the sudden stoppage of the railways, but the men, I think, were provoked by the long delays and other circumstances which occurred in the last days of the negotiations. The lesson of this stoppage is that the heads of the Government and the heads of great bodies of organised workmen should never act suddenly, but should always be willing, if asked, to give a little more time for deliberation, especially where the interest and convenience of millions of people may be involved."

The imperative necessity of patience, deliberation, and sincere goodwill on both sides has indeed been amply demonstrated by this unfortunate affair; but there are other lessons of no less importance to be derived from it. The most impressive of these, perhaps, is the wonderful composure and adaptability of the British public, which when suddenly confronted with the complete withdrawal of its principal means of transport simply "carried on" as best it could with other means, displaying remarkable good-humour and self-control. The *sang-froid* of the Englishman was never more strikingly evinced, and we are proud to belong to a nation which comports itself so admirably in a great emergency. It is clear from what we have seen that the nation cannot be stampeded, and that the possibility of a successful revolution in this country is too remote to call for further notice. The strike, in fact, which was ostensibly an industrial dispute—though Mr. Lloyd George plainly regarded it as an experiment in preparation for a

sterner struggle—has proved to demonstration that the policy of "direct action" is a hopeless one.

So much for the psychological aspect of the subject. The principal lesson to be derived from its material side, is the immensity of the physical and mechanical resources of this country, as exemplified in the rapid development of a substituted system of transport and the revelation of the abundant supplies of food and other necessaries that were available. It is clear that, under similar conditions in the future, the lightning railway strike has been shorn of its terrors, while the enthusiastic response to the call for volunteers shows that a strike of transport workers would be equally futile. So efficient and satisfactory has the motor transport service proved during the strike that it is to be continued with a view to relieving the congestion at the docks and elsewhere.

From the labour point of view, the success with which not only road motors, but even the railway services, both steam and electric, have been manned, affords a further testimony to the adaptability of the Briton, and deals a blow to the theory that long training is indispensable to the performance of such duties. Granted that long training is desirable in the interests of safety and efficiency—but, as was demonstrated in engineering workshops during the war, so also in these other *rôles*, it is clear that an intelligent man can be quickly trained up to the standard at which he can safely be called upon to enter upon his functions in actual service.

All these considerations combine to reinforce our confidence in the stability of our social system, and its inherent strength to withstand any attempt to accomplish its overthrow. They will also prove a wholesome deterrent to rash and unnecessary dislocations of the industrial machinery upon which this country depends for its subsistence.

In conclusion, we are bound to compliment the Government departments and the emergency officials who were suddenly called upon to face an unprecedented crisis, upon the extraordinary efficiency and completeness of the organisation that had been prepared and was so quickly developed. The ability of the Briton in this capacity was triumphantly demonstrated during the war; it was no less conspicuous in the conduct of this domestic conflict, and the greatest credit is due not only to the organisers, but also to the workers who took part in it.

GERMAN COMPETITION IN A NEW FORM.

A new form of German competition has arisen both in the engineering and other industries as a result of the world-wide war and the conclusion of peace, although the new method cannot continue indefinitely. In pre-war days we had long become familiar with dumping, which can only be practised by countries having a highly-protected inland market—which permits home manufacturers to charge high prices to native customers. The principle of dumping is based upon that particular form of production in bulk which allows of the sale in the inland market of, say, 60 or 70 per cent. of the total production at high prices which yield large profits on the total output, so that the balance of 30 or 40 per cent. can be exported at cost prices or even at lower than the cost of production. It is impossible satisfactorily to meet this kind of competition unless it is counteracted by legislative sur-taxes on imports, such as those which were first introduced by Canada and since adopted by certain other countries, or unless such a method is prohibited by international treaties. But this system has come to an end in the case of Germany, at least, for a long time—a very long time—forward. The circumstances attending the revolution in Germany and the defeat of the country in the war, however, have produced a new form of competition which is founded upon the depreciation of the German currency in international exchange.

The Germans are in urgent need of foreign exchange in order to pay for the acquisition of food products and raw materials. In order to obtain this exchange they are compelled, except in the case of coal, when they have any tonnage to export, to sell in German mark currency, and they receive payment according to the rate of exchange prevailing on the date of payment unless other arrangements are made. It thus happens, as indeed several cases have arisen recently both in Holland and Belgium, that machinery and plant have been offered, quoted in marks, at prices which are about one-third of those at which British firms are able to tender, when the German currency has been converted into florins or francs as the case may be at the existing rate of exchange. In other words, the Dutch and the Belgians are able to purchase at one-third of the price charged by British firms owing to the great depreciation of the German currency. But the mark will appreciate in the course of time, and in the meantime this form of competition, whether supported by the German Government or not, may be expected to continue. How to meet this kind of rivalry, which has now extended also to the Scandinavian countries, is a problem which the Chamber of Commerce of Stockholm hopes to have solved.

The Stockholm Chamber of Commerce, at the request of the Government Committee on Customs Tariffs and Commercial Treaties, which has investigated the question of the revision of the Swedish tariff, has sought for and obtained the views of representative industries as to the future course which, in their opinion, the tariff should follow. The report of the chamber deals in particular with the engineering industry, and the branch concerned with the manufacture of electrical apparatus and instruments. Speaking on behalf of the former, the report states that the present degree of protection afforded by the *ad valorem* duties is inadequate, and in some cases purely illusory in consequence of the changes in the prices of raw materials and the conditions of exchange. The Chamber, therefore, suggests that in the revised tariff the *ad valorem* duties should be adapted according to a constant market price, and that a special protective clause should be introduced which would take into consideration the abnormal rates of exchange. What this proposal would seem to imply is, for instance, that if German machinery were offered in Sweden on the basis of the depreciated German exchange, the machinery would be liable to a surtax which would bring the sale price up to the normal level which prevailed in former peace times. It would certainly be a very heavy impost, having regard to the present very low value of the mark. We merely mention this incident as a matter of interest, leaving it to the Swedish Government to deal with on its own account. In the case of electrical apparatus and instruments, the apprehension prevails that in the new era of peace, makers will be crushed by the big works in Germany and the United States unless the existing measure of protection is increased. The manufacturers, consequently, ask for a rearrangement of the *ad valorem* duties and an advance from 10 to 20 per cent. The question of a protective clause for electrical apparatus and instruments is not mentioned, although it is reasonable to assume that it is intended that such a clause would apply also to these branches as well as to the heavy electrical and mechanical engineering industries.

Electrical Power from Belgium to Italy.

In Italy, as in most countries, one of the pressing questions of the hour is the coal problem, which is, above all, one of transport. A somewhat novel solution is proposed by Prof. E. Guarini, of Brussels, who, we understand, has already submitted it to the Belgian and Italian Governments. His proposal is to

replace the present railway transport of coal from Belgium to Italy by the transmission of the heat energy of the coal in the form of electrical energy. According to Prof. Guarini's circular, an agreement exists with Belgium for the delivery of 60,000 tons of coal monthly in exchange for silk, minerals, and other Italian products, but this quantity of coal is insufficient in view of the growing needs of the Italian industries, especially until such time as the big hydro-electric schemes under consideration in Italy come to fruition. In fact, at least a million tons of coal per month would be required. The difficulty is one of transport, not of labour, and large stocks of coal exist in the mines.

Prof. Guarini's idea is to generate electric power in large central stations situated in the Belgian coalfields, and to transmit from 500,000 to 1,200,000 KW. at a pressure of 150,000 volts by overhead lines through France into Lombardy, a distance of 1,200 km. (746 miles), with direct current! Allowing a line loss of 20 per cent., he estimates that the amount of copper required for an overhead line of 1,200 km. under these conditions would be 234 kg. per KW. delivered, at a cost, including erection, of 1,170 fr., to which he adds 20 per cent. of this sum to cover the expenditure entailed for poles, insulators, &c. The total capital cost for transmission would thus work out at 1,404 fr. per KW. received in Italy. By taking 12 per cent. per annum for interest, amortisation, and maintenance, say, 168 fr. per KW.-year received, reckoning upon a load factor of 57 per cent., say, 5,000 hours per year, and adding the line loss of 20 per cent., he arrives at a total transmission cost, in round figures, of 4 centimes per KW.-hour received. On the other hand, on the basis of the cost of transport of coal in Belgium, at 15 centimes per ton-km., and 2 kg. of coal (actual price in Belgium, 50 fr. per ton at the mine) per KW.-hour at the switchboard, he calculates that the cost of railway transport of the equivalent amount of coal for the same distance would be 36 centimes. Assuming half this figure to represent the probable actual cost, he finally concludes that the electric transmission would be 8 centimes, whereas the cost of railway transport would be 18 centimes—more than double. Prof. Guarini's contention is that even if the electric transmission should prove more expensive than sending coal direct by rail or by sea, it would assist in solving the transport question, and would bring about results beneficial to both countries.

The scheme is, we think, by far the most ambitious proposal of its kind that has ever been put forward. It does not appear from the information before us that the cost of the sub-station plant at the receiving end, which forms part of the transmission cost, has been allowed for, and while there is no insuperable difficulty in generating direct current at 150,000 volts, the enormous power involved could not be dealt with in this way without a vast amount of experiment and research. If three-phase transmission were substituted, this difficulty would be removed, but the cost of transmission would be increased. Apart from this consideration, however, the construction of the generating and converting plant and of the transmission line would surely occupy a much longer period than would be required to develop the Italian water powers. Unless the transmitted power were permanently necessary in addition to the local hydro-electric power, it would not be commercially practicable to carry out so costly a scheme, and, finally, the complicated political questions that would have to be settled would throttle it. Still, the proposition is interesting, if only on account of its magnitude.

Housing Schemes.

In our issue of February 28th, 1919, we drew attention to the activity of the British Commercial Gas Association in connection with the national building schemes, and the absence of any like propaganda on the part of the electrical industry; we also quoted the report of the Committee appointed to consider the construction of workmen's dwellings, in which the advantages of electricity for lighting cottages were effectively set forth.

Since then the Electrical Development Association has taken the field, and we can count upon it to exert every effort to secure for electricity that place in the cottage home which is its due. But it is not lighting only that we have in mind—the advantages of electricity for cooking are unequalled by those of any other agency, and to ignore them is to injure the interests not only of the industry, but also of the workers concerned. Yet in a "Manual on the Conversion of Houses into Flats for the Working Classes," recently issued by the Ministry of Health, we have not found one word about the subject, though in the plans provided for the guidance of owners and local authorities a gas cooker is shown in every kitchen. Why should gas be continually forced down the throat of the working man by the Government?

The lighting, heating, and cooking arrangements in large houses converted into flats will have to be drastically modified, and electricity lends itself admirably to this purpose, while its use would immensely conduce to the comfort and convenience of the tenants. The fact that electric cooking can be carried on without fumes, odours, or rise of temperature in rooms never intended for such a purpose makes it an ideal method in this connection, and its perfect cleanliness and safety would greatly reduce the labour and anxieties of the housewife. Efforts should be made to induce the Ministry to realise the facts, and to afford special facilities for the adoption of electricity for every possible purpose in the home of the worker.

Electricity in Factories.

Not much has been heard from Mr. G. Scott Ram, H.M. Electrical Inspector of Factories, during the war, but elsewhere in this issue we give an abstract of his report covering the four years 1915 to 1918. Naturally, the report is largely concerned with the manufacture of munitions and the conditions under which it was carried on; it is gratifying to note that, in spite of the very extended use of electric power for this purpose, and the large amount of new plant that was hurriedly installed in the factories, new and old, in not a single case was any fire or explosion traceable to the electrical installation. Mr. Ram significantly observes that, while the national electricity supply scheme may eventually lead to great economies, it will be imperatively necessary to sanction extensions of many of the existing smaller stations in the meantime, if the extended use of electrical power is not to be retarded; there are other considerations also which will have to be taken into account in this connection, as we shall show on a later occasion.

The firm footing which electric power has secured in iron and steel works, where we shall soon see "everything electrical," is the subject of comment. As in the case of many other new applications of electricity, the dangers which may attend its use in the hands of the inexperienced are exemplified in the careless arrangement of the high-pressure equipment of furnace transformer rooms; but there is no need to run these risks, provided that the plant is installed under competent supervision. In the early days of electric railways many regrettable accidents took place, until the staff and the general public learnt to treat live rails with respect. Fortunately, the number of accidents recorded has been remarkably small; the number of fatalities, it is true, is larger than in the previous four-year period, but still far less than proportionate to the greatly-extended use of electricity, particularly of alternating current, which has made great strides during the war. Nearly all the fatal accidents occurred on A.C. circuits, and the great majority were on factory premises. We note with regret that in half the fatal cases artificial respiration was not tried, and in several instances where a doctor was present "practically no attempt was made to revive the patient. This indicates that the medical profession generally is woefully ignorant on the matter." This is very sad reading, and we trust that efforts will be made, through the medium of the medical Press and by other means, to convey to medical men correct information on this important subject.

SOME NOTES ON FAULT LOCALISATION.

By G. W. STUBBINGS.

Much has been written on the subject of the localisation of faults on underground cables, and this matter, which at one time was regarded by many mains engineers as somewhat abstruse and highly technical, is at the present time rather commonplace. It is the experience of most mains engineers that, in actual practice, fault-localisation tests are not infallible, and sometimes give erroneous results, and it is perhaps for this reason that testing for cable faults is occasionally regarded as somewhat of an uncertain or haphazard process, which will in eight or nine cases out of ten give good results, whilst in the other one or two cases, one is "let down" hopelessly, and much delay and vexation in rectifying cable breakdowns is occasioned. This view of fault-localisation tests is hardly a sound one, for localisation tests are based on elementary principles of electrical science, and provided the assumptions upon which the method is based are valid, and the necessary measurements correctly performed, the test is bound to give an accurate result. Failure to obtain accurate results in fault localisation is due to the infringement of one of these two conditions, and hence, in carrying out tests of this kind, it is important to endeavour, as far as possible, to fulfil the conditions for obtaining an accurate result, and, should it be impracticable to do this completely, rightly to estimate the extent to which these conditions are infringed in order that the probability of inaccuracy in the result obtained may be correctly gauged. Localisation tests are of a very simple character compared with many laboratory tests, and it is not difficult to devise theoretical methods applicable to almost any circumstances attending a cable breakdown. It is in the accurate performance of the test that difficulty is experienced; the conditions under which such a test is carried out—under a jointer's tent, and often either in wet weather, or with an admiring audience of school children not pressed for time—make accurate work very much more difficult than in the more favourable conditions of the test-room or laboratory.

The determination of the length of the cable under test is usually carried out at the time of the test, and in doing this it is advisable to chalk and number the successive tape lengths on the ground boldly, as these marks will be useful in locating the position of the fault from the result of the test. The length of the cable, as measured, requires to be corrected for the joints on the section, the usual rule being to allow one yard for each joint. It may be remarked that this allowance must be made for every service tapping in the case of the outer of a concentric main, and also for every inner service joint in the case of the middle conductor of a triple-concentric cable. Allowance must also be made for the testing leads if necessary, but it is usually possible so to arrange the test that the equivalent length of these leads in terms of the faulty cable need not be allowed for. The result of the corrections is to give a fictitious length to be used for purposes of calculation, and it must be borne in mind that the distance of the fault as found by the test is also a fictitious one, this distance having to be corrected for joints in order to obtain the actual number of yards from the testing position to the fault. This will be made clear by a consideration of fig. 1.

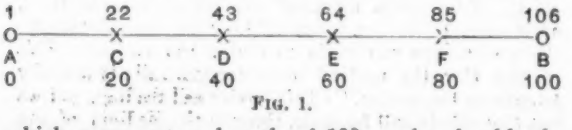


Fig. 1.

which represents a length of 100 yards of cable, in which there is a joint every 20 yards, the testing wires at each end being attached to a fitting in a disconnecting box. The lower figures give the actual distances in yards from the testing position A, the upper figures giving the fictitious or "equivalent" distances used in the calculations. If the result of the test gave the position of the fault as 82 yards from A, it is seen that the actual position will be two yards to the left of joint F, or 78 yards only from A.

It has been frequently pointed out that in tests carried out according to the bridge method, the leads connecting the cable loop to the bridge should be in the slide wire arms. The slide wire used is generally 1,000 mm. long, and if each half of this wire be reduced by a length equal to the equivalent length of the connecting leads in terms of the wire, the nominal value of the slide wire circuit remains 1,000 mm., and calculations are simplified. Even if the length of the slide wire is not so reduced, the additional calculation can easily be performed mentally. If n is the equivalent length in millimetres of slide wire of each of the testing leads, and x is the position of the movable contact which gives equilibrium of the bridge, the factor by which the length of the faulty cable must be multiplied to give the distance of the fault from the testing position is $(x+n)/(1{,}000+2n)$. This expression is nearly equal to $(x+n)/1{,}000\times(1-2n/1{,}000)$, and the actual factor required can be found mentally from x, by adding to it the equivalent length of one testing lead, and subtracting the same percentage as that of the resistances of the two leads to that of the slide wire. If, for example, x is 564, and n is 3, the mental calculation will be $564+3-0.564\times6$, or $564+3-3=564$.

Care must be taken in making up cable loops for localisation tests that the faulty and sound cables are either connected together without appreciable resistance, or, what is almost as good, that allowance is made for the resistance of the connection. A piece of 7/22 cable seems to the uninitiated to make a very good connection between two adjacent fittings in a disconnecting box, but when it is considered that the resistance of 3 in. of cable of this size is equal to that of 2½ yards of 0.15, and that, moreover, the customary allowance of 1 yard should be made for each clamped connection, it will be understood that neglect to make the necessary allowance of 4½ yards in the loop will introduce considerable inaccuracy when a fairly short length of cable is being tested.

Fall of potential tests are usually in greatest favour in direct-current systems, owing to the ease with which current can be obtained from the mains for testing purposes, by the use of a bank of lamps. In these tests it is usually assumed that the current is constant throughout the test. This assumption is usually a fairly legitimate one, especially if the fault be a low-resistance one, and it be possible to use a small testing current. In this case any small variations in the resistance of the fault will not, owing to the relatively high resistance of the test lamp, cause much variation in the total resistance of the circuit. There is, however, one case in which the assumption of a constant current during the test may not be justified, this being that in which two testing leads from the testing position to the far end of the cable are utilised. When this is the case, it is well known that the testing current can be taken to the remote end of the faulty cable by one wire, the other wire being utilised as a pilot wire for the testing instrument. In these circumstances, if the length of cable being tested is considerable, and the testing cables be of small cross section, the resistance of the wire conducting the

current to the remote end of the faulty cable may be sufficient to cause an appreciable difference between this current and that which is fed into the other end. Moreover, if the faulty cable be of small cross section, and of considerable length, the resistance of the path of the current from one end of the cable to the fault will generally be different from that from the other end, and this difference may also introduce a variation in the testing current. The further possibility of variation in the supply voltage has also to be kept in mind. The way to ensure accuracy in fault localisation by the fall of potential method is to have an ammeter in circuit with the bank of lamps supplying the testing current, and to take simultaneous readings of the ammeter and the millivoltmeter. Any variation in the current can then be easily allowed for, and provided the equivalent length of the faulty cable has been correctly determined, the result of the test is certain to be accurate.

Bridge tests for fault localisation have the advantage that they are not susceptible to inaccuracy through variation of the resistance of the fault. Bridge tests can be arranged with the fault either in the battery or in the galvanometer circuit, and when using current from direct current mains are very convenient, giving very trustworthy results, provided a suitable cable loop is obtainable, and that the resistance of the slide wire is of the same order as that of the loop. The ideal cable loop is one in which the sound cable is of the same cross section and length as that of the faulty cable—such conditions being realised in the case of an outer fault on a concentric cable. If a cable of different cross section has to be used to complete the loop, the bridge will be more sensitive if this cable be of larger cross section than the faulty cable. The use of a cable of different cross section, for a loop test, always, however, introduces possibility of error, in that the ratio of the resistances per yard of the two halves of the loop is rarely known with certainty. It may be well to say that it is perfectly simple to eliminate from the test the uncertain equivalent length of the return cable, by making a loop test from each end of the faulty section—using the same loop in each case. If a and b be respectively the factors of the length of the cable loop giving the distance of the fault from the first and second testing positions, x the distance from the first position, l the length of the faulty cable, and m the unknown equivalent length of the return cable, we have $x=a/(l+m)$, and $l-x=b/(l+m)$. From these two equations we obtain at once $x=la/(a+b)$, in which expression m, the unknown length does not appear. Unless therefore the return cable is large compared with that under test—in which case a small error in calculating its equivalent length will obviously not greatly affect the accuracy of the final result—or the respective cross sections are known with a good degree of certainty, it is always advisable to carry out the duplicate test, and so eliminate the uncertain quantity. When conducting bridge tests, and the testing current is taken from the mains, it is well to limit this current to the smallest amount possible. The contact resistance of the slider with the wire is fairly high, and any appreciable sparking will soon burn and pit the wire sufficiently to impair the uniformity of cross section upon which the accuracy of the test depends. The condition for maximum sensitiveness of the bridge is a point that is often overlooked. This condition has been referred to above, and if the difference between the resistances of the two circuits be considerable, it will be found that the galvanometer does not respond well to small variations in the position of the movable contact, a state of affairs making accurate localisation impossible. If the slide wire were either of very much higher or very much lower resistance than that of the cable loop a variation of the position of the movable contact over the entire range of the slide wire would produce practically no deflection of the galvanometer.

Fault-localisation tests on alternating-current networks are considerably more troublesome than those in direct-current areas, in that current for testing purposes has to be obtained from a battery brought to the job. Special batteries for this purpose are usually kept at the works, but it not infrequently happens that when they are required for testing purposes they are badly in need of charging. Every care should be taken of these testing batteries, and they should be charged and discharged regularly, a duplicate set being provided that this may be done. Much delay in rectifying a cable breakdown in an alternating-current area can be caused by lack of care in attending to the testing batteries.

In view of the low voltages available for fault localising tests on A.C. networks, the methods in which the testing current is passed through the fault cannot so frequently be applied as in direct-current systems, owing to the fact that with these low voltages it is often impossible to pass sufficient current to obtain good readings. In these circumstances it becomes necessary to resort to the methods in which the fault is in series with the galvanometer. Since there is always a small E.M.F. in the fault it is necessary, in bridge tests, to balance to a false zero. There is accordingly introduced into the test an additional possibility of error. In a fall of potential test the E.M.F. in the fault can be eliminated by reversing the direction of the current in the loop, taking readings of the instrument before and after reversal. The mean of these readings will give the true fall of potential required. Unless the instrument is of the central-zero type, it will be necessary to reverse the connections to the instrument simultaneously with the reversal of the current in the loop. It is always advisable, however, to endeavour to obtain sufficient current through the fault, either by breaking it down or by the provision of additional battery power, to arrange matters that the galvanometer or millivoltmeter is connected across the cable loop.

Concentric cables are used for high-tension feeders for single-phase systems, and frequently for two-phase schemes, the outer of the cables being earthed at the generating station. This system of distribution has the great advantage that the outer conductor of the concentric cable also serves as a kind of test sheath, by which the state of the insulation of the live conductor can be gauged. A low test of the outer insulation will not indicate usually the fact that a breakdown is imminent, since a total failure of this insulation would not affect the supply. Such a low test, however, gives timely warning of what would be a future fault on the inner conductor. It is, however, by no means an easy matter to locate a high-resistance fault on such a feeder. To break this fault down completely would be an easy matter, but such a procedure might probably destroy the insulation of the inner conductor, and not only put the cable out of commission, but also do away with the advantage of a sound inner to serve as a return in the cable loop. The best method of dealing with such a case appears to be the use of the fall of potential test by making the concentric feeder a cable loop, and passing as large a current round the loop as means will permit—up to the carrying capacity of the cable. Since such a test will usually be carried out at the central station, means for obtaining a considerable direct current will probably be at hand. With a fairly long cable loop and a sufficiently high current it will often be possible to obtain a sufficient drop to give fair readings on a sensitive instrument, even through a fault of as high a resistance as 50,000 ohms. With a cable loop formed by 500 yards of 0.1 sq. in. concentric cable, a current of 50 amps. will give a total drop of 12 volts. With this voltage the sum of the currents in the testing instruments when connected to the two ends of the loop will, with a fault of 50,000 ohms resistance, be 240 microamperes. With a total drop as high as 12 volts the effect of any E.M.F. in the fault will be

negligible. It is barely necessary to say that, when carrying out a test of this kind the insulation resistance of the source of testing current must be of a very much higher order than that of the faulty cable.

Tests for locating short circuits on a concentric cable without an independent return cable for a loop illustrate the necessity of ascertaining how far the assumptions upon which the legitimacy of the test is based, are justified. The simplest test of this kind, where there are tappings of the cable available, is to pass a constant current through the fault from one end of the main, and to ascertain the voltage between the two conductors at the testing position, at the far end, and at a tapping where the voltage is intermediate between those at the ends. On the assumption that the resistance of the fault remains constant, it is possible from the data observed, and from the distance of the tapping used from the testing position, to obtain the drop per yard in the cable, and the total drop from this position to the fault, from which the distance of the fault can immediately be calculated. Constancy of fault resistance is, however, not usual, and if this resistance vary much the test will be valueless. The test should, therefore, be so arranged that this degree of constancy is kept under observation, and this can be done either by using a battery of fair capacity in series with a resistance of negligible temperature coefficient to supply the testing current, when the reading of an ammeter in circuit should remain constant if the fault resistance does not vary; or by keeping the testing current constant by regulation, and having an instrument connected at the far end of the cable, whilst the other two readings are being taken, so that the constancy of the drop across the fault may be observed. With regard to this method of locating short circuits, it may be worthy of note that should there be found no service tapping that will give a reading intermediate between the two others, this will indicate that the fault is between the testing position and the first tapping. If the test is repeated from the other end of the cable a suitable intermediate point can obviously be obtained.

Faults in which the cable is burnt completely asunder cannot usually be localised with any degree of accuracy, excepting in circumstances where the inductive method is applicable. In other circumstances the best that can be done in the way of testing is to rely upon readings obtained at service tappings. If the cable has burnt itself clear, and will stand the supply voltage, the burn-out can be located to a length between two services by testing with a lamp. If the ends of the cable are earthed, it is sometimes possible, by passing as heavy a current as practicable into the faulty main to locate similarly by testing with a millivoltmeter at services. This test will be indefinite, however, in that it may not be certain when the fault has been passed, unless precautions are taken to prevent any small voltage appearing on the portion of the main not carrying current. The simplest way to prevent this is to connect the far end of the faulty main to earth, also short-circuiting all conductors in the case of a concentric or multicore cable. If this precaution be taken the position of the fault should be obtained to a length between two services.

Fault-localisation tests are carried out under the worst possible conditions, and are not made easier by the fact that usually time is a most important consideration. Whatever be the urgency of the particular case, if a test is to be attempted, the test itself should not be hurried, and every possible care should be taken to ensure accuracy. It should be remembered that if an erroneous result is obtained, not only is the time spent on the test absolutely wasted, but further loss of time is occasioned by a fruitless search for the fault at the wrong place. The need for accuracy applies as much to the actual calculations as to the measurements and readings. The writer has found it advisable to work out all results arithmetically, and if possible to get the calculations checked. The slide rule is an exceedingly useful device, but, unless it is in constant use, is liable to give wrong results even in the hands of the best of men.

Although it is good practice, and the mark of an efficient mains engineer to attempt a localisation test in the majority of cases of cable breakdown, it by no means follows that a test should invariably be made before cutting. The advisability of testing depends upon a variety of circumstances, chief amongst these being the accurate result, and the time taken to perform the test. In the case, for instance, of a distributing main supplying a large number of consumers, it is usually advisable to cut pretty freely in order to restore the interrupted supply to as many premises as possible. Whilst a test is being performed, and, indeed, whilst the testing gear is being brought from the works the jointers are at a standstill, and nothing is being done; on the other hand, the first cut will enable one half of the consumers on the main to use their lights. The reaction against the "cut and try again" method of fault localisation in vogue in the early days of electricity supply has in many instances engendered a feeling that a localisation test should be attempted in all circumstances. Although the old method is a barbarous one, there are many cases in which it is the best, at any rate till the faulty length is so far reduced that the number of consumers deprived of their light is sufficiently small to be unimportant. The question as to whether or no a test should be attempted is one that must be decided by the engineer at the time, and this decision, moreover, must be made promptly. Once a course of action is decided upon, it must be carried out with vigour, determination, and without misgivings as to its soundness or advisability.

A D.C. TESTING BOARD FOR AN ELECTRICAL REPAIR SHOP.

By JAS. WALKER.

There is an old saying that as regards boots the worst-shod man is the cobbler himself; but the same saying could quite well be applied to the workshops of other trades, and none more so than electrical repair shops.

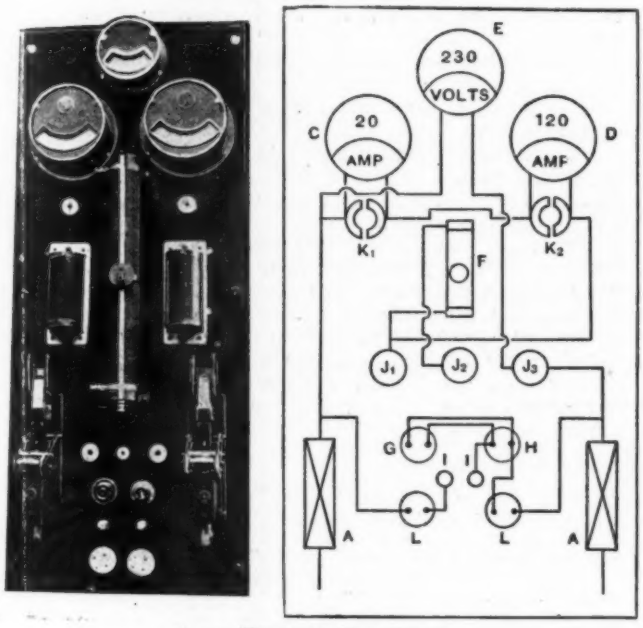
How often does one find, for instance, that to get a portable lamp tried for light or a cartridge fuse tested to see if it has blown or not, a great deal of time is lost by not having ready means available to make these tests. Then, again, a motor is sent out to a contractor's shop for repairs to the armature or field coils, and when ready for test the sender's engineer is usually called in to witness the test run. What the writer usually finds on these jobs is a conglomeration of cables lying on the floor, several valuable instruments likewise, plenty of oil floating about, and a few bare joints to take up one's attention. All are necessary, no doubt, but none are in their proper place. This state of affairs applies to factory repair shops as well as contractors', and this, coupled with the fact that very often small armatures are to be seen lying on a heap of bolts, screws, tools, &c., on the benches, does not tend to give one a favourable opinion of the quality of work turned out in these shops.

In all the visits to electrical shops in public works and contractors' shops which the writer has had to undertake in the course of his duties, only in a few instances has it been noticed that an attempt has been made to rig up some kind of arrangement for testing purposes. None, however, have embraced the most essential connections and instruments required to carry out every-day tests, off one common board.

It is, therefore, with the feeling that the board described and illustrated below will be of interest to readers, that these lines have been written.

The board shown in the illustration has been made up to enable the every-day tests to be carried out without anything further to do than to connect the leads of the apparatus to be tested. The uses to which the board can be put are, to test single lamps, portable lamps fitted with adaptors or with plugs, apparatus in series with a lamp, armatures for drop test, to pass current up to 8 amperes, or up to 120 amperes, and for charging accumulators.

The mountings are usually found out of commission in electrical repair shops, and comprise :—Two S.P. circuit breakers, A A, with their no-volt coil resistances, B B, which may not be required, ammeter C up to 20 amperes, ammeter D up to 120, voltmeter E reading voltage of supply, in this case 230, slide wire resistance F, 5-amperes socket G, batten holder H, two small terminals I I, three main terminals J_1, J_2, J_3, and two ammeter cut-outs K_1, K_2, and two fuses L L.



A D.C. Workshop Test Panel.

The slate panel on which all are mounted is part of an old fused panel, the old holes being plugged up and black varnished all over. The board measures 48 in. × 20 in. × 1½ in., and is mounted on an iron frame made of 2 in. × ½ in. stuff, and projects 4 in. from the wall.

When testing a motor or other apparatus which requires between 20 and 120 amperes, the smaller ammeter should be cut out by means of plug K_1, but when requiring up to 20 amperes only, the larger ammeter can either be cut out or left in circuit, as desired. To obtain the highest amperage the terminals J_1 and J_2 are used, and for the smaller amperage J_2 and J_3. The amperage available between the two latter terminals depends, of course, on the sliding resistance obtainable. The one fitted on the board here illustrated passes a maximum of 8 amperes.

The board has proved to be very convenient, and well worth the time spent on fitting it together.

Finland's Potential Water Power.—In view of the shortage of fuel throughout Europe, and the important part which the British electrical industry may hope to play in establishing hydro-electric systems, some figures in regard to the water power of Finland are interesting. Out of a total estimated water power of 3,000,000 H.P. at average water level, specialists consider about 1,050,000 H.P. to be of direct use for industry. Of this, only 150,000 H.P. is at present utilised, thus leaving considerable possibilities of development.

Of the 79 waterfalls in Finland with potential capacities of horse-powers from 5,000 to 300,000, 42 range from 5,000 to 20,000 H.P.; 25 from 20,000 to 50,000 H.P.; 6 from 50,000 to 100,000 H.P.; and 6 from 100,000 H.P. to 300,000 H.P.—*Bulletin* of the F.B.I.

FUEL ECONOMY IN GERMANY.

By COSMO JOHNS and LAWRENCE ENNIS.

(*Abstract of paper read before the* Iron and Steel Institute.)

This report is a statement of facts and inferences based on observations made in the occupied territories on the left bank of the Rhine by the authors, when members of a Commission appointed by the Government to investigate the German iron and steel industry in the occupied territory.

The problem of fuel economy in the iron and steel industry is not completely envisaged until it is realised that pig iron is not the only useful product of the blast-furnace. The gas produced in such prodigious quantities is, when properly cleaned, the ideal fuel for internal-combustion engines. The combustible gas must be produced, and is as much a product of the furnace as the pig iron. It is in the direction of utilising to its fullest possible extent the fuel-gas produced that progress in fuel economy lies, and it is here that German practice has concentrated its efforts.

There was evidence in every place we visited that the importance of the effective cleaning of the gas was fully realised, and effective cleaning begins after the gas leaves the ordinary dust-catcher. We did not observe a single instance where uncleaned gas was used for stoves or boilers. Some system—wet or dry—was almost always used to reduce the dust content of the gas to about 0.1 gramme per cu. metre before it was used for any heating purpose whatever. The second cleaning for such gas as was used in internal-combustion engines was almost invariably accomplished by Theisen washers. These not only reduced the dust content to from 0.001 to 0.003 gramme per cu. metre, but also served to cool the gas.

Nothing that we saw during our visit was more suggestive or instructive than the use made of large gas-engines. The large central stations with ten, twelve, or more gas-engines of from 1,500 to 5,000 H.P. visited at so many works were eloquent testimony to the value of the internal-combustion engine for the utilisation of fuel-gas. Blowing-engines for the blast-furnaces, for the Bessemer converters, and for the generation of electric power were nearly always gas-driven. The more modern the works, the more were large gas-engines used. For the units favoured in iron and steel works for blowing-engines or electric generators the gas-engine is not only the most efficient, but it uses the fuel-gas that is normally and necessarily produced by the blast-furnace—a fuel on which the only real cost incurred is that for collecting and cleaning it. Starting with the cleaned gas the alternatives are steam-raising and using the steam in turbines, or using the gas in internal-combustion engines. The overall efficiency from fuel to power generated is greatly in favour of the gas-engine. The large installations in nearly every works we visited were convincing proof that the large gas-engine using cleaned blast-furnace gas was a reliable prime-mover. The table at the end of this report shows the installations of large gas-engines at works. It is by the fullest possible use of blast-furnace gas in large gas-engines for the compression of air for blast-furnaces and Bessemer converters and the generation of electrical energy for transmission to rolling-mills, and other steelworks' plant, that fuel economy can be secured, for in this way, and this way only, can a considerable surplus of gas be obtained for such steam-raising as may be found necessary, and for furnace-heating. This was the policy of the works we visited, and the more modern the works, or the more recent its reorganisation, if an old one, the more completely was it carried out. The gas-driven electric generators do not respond to the fluctuating demands from the steelworks, and the usual practice was to install some steam-turbine-driven generators to assist the gas-driven generators, and thus form an elastic combination. But the gas-engine was the predominant partner. At the Volkingen works in the Saar Valley a waste-heat boiler had been installed to utilise the sensible heat of the exhaust gas of a 3,000-H.P. gas-engine, and so successful had been its performance (said to be 13 cubic metres of water evaporated at 15 atmospheres pressure with considerable superheat) that a second boiler was being put down. This example was convincing evidence that effective use can be made of the heat in the waste gases from large gas-engines. If at the same time the cooling water of the gas-engine were used as feed-water for the waste-heat boiler, we should have a combined efficiency unapproached by any other prime-mover. That this is the direction in which further economy in the consumption of fuel can be obtained is clear. The more the gas-engine can be utilised for power and air blast production, and the less the call on gas- or coal-fired boilers, the greater will be the economy measured in fuel consumption—from ore to finished steel—per ton of product.

The rolling-mills and auxiliary machines are large consumers of power, and therefore of fuel. The internal-combustion engine, despite its high thermodynamical efficiency, is not available, owing to its proved inability to meet, when directly coupled, the rapidly fluctuating demands of a rolling-mill. The electric motor helps to get over the difficulty to a considerable extent, for the central power-station, with its gas-driven generators and steam turbines, has less violently fluctuating demands to deal with. It would, we consider, be generally agreed that mills of 36-in. diameter and under can be economically driven electrically, while for the smaller machines electrical power would always be preferred. It is

when the large blooming-mills come to be considered that diversity of opinion will become apparent. The weight of evidence, as shown by current practice, was distinctly against the electrical driving of such large mills under the conditions that prevail in the areas visited, but the objections seemed largely based on the rapid and considerable variations in the power consumption of such large mills. This rapidly varying load would perhaps impose too heavy a burden for the power-station of a single works to carry, but the linking-up of neighbouring power-stations, such as we found was the case in Luxemburg, would be an obvious remedy. At the great Hagondange works completed by Thyssen, near Metz, just before the outbreak of war, the steelworks is completely electrified and the large blooming-mill has a 16,500-H.P. motor at each end of the rolls. We must, however, put on record the fact that the majority of mills we saw were steam driven.

The electrostatic process for the precipitation of dust or fume was devised by Prof. Cottrell to remove the flue dust or fume in the voluminous output of waste gases in certain non-ferrous smelting operations. Once its virtues were recognised its adoption made remarkable progress, and the days of the old bag systems for filtering the dust from the gases seem numbered. The bag system is expensive to erect and to maintain. It is but natural that the application of the Cottrell system to the cleaning of blast-furnace gases was suggested, and it is understood that experiments are in progress in England. If successful, there should be a wide field open for a system with so many advantages. It would still be necessary to use a final washer, such as the Theisen, for the cooling, if not the cleaning, of the gas used in the internal-combustion engines. A further advantage would be that there would be no considerable cooling of the gas used for stove heating or boiler firing, except that lost in transmission.

Our conclusions may be summarised as follows:—(1) The blast-furnace gas should be cleaned, without loss of sensible heat, if the conditions render it possible, until the dust content is at least as low as 0.1 gramme per cubic metre. It is only when this has been done that the gas can be used economically for any purpose in iron and steel works practice. Gas intended for use as fuel in internal-combustion engines should of course be still further cooled and cleaned. (2) All power, whether compressed air for blast-furnaces or converters, or electric energy, should be generated in gas-driven prime-movers with only such steam turbines as are found necessary to deal with fluctuating loads. As much steam as possible should be furnished by waste-heat boilers attached to the large gas-engines. These waste-heat boilers should be of the fire-tube, not water tube, type. (3) If the linking-up of the power-stations of neighbouring works is possible, then the whole of the steelworks should be electrically driven.

These three conclusions would reduce the number of steam boilers to a minimum. The great works at Homécourt, just inside the old French frontier not far from Metz, only used about 40 tons of coal per twenty-four hours before the war for its large output. Here we have an actual example of a negligible coal consumption. The coke used in the blast-furnaces produced enough gas to furnish practically all the other fuel required in the iron and steel works. It is not always recognised that the modern blast-furnace is the most efficient gas-producer in existence to-day, and that the gas produced is the ideal fuel for the most efficient type of prime-mover that we have available. In a district where there is a large demand for electric energy, it might be profitable for the steelworks to sell it and use solid fuel in the works for heating or steam raising, but this would depend on the local demand, and its expediency would be decided by local conditions.

Examples of Installations of Large Gas Engines.

Works.	No. of blast-furnaces.	Gas driven.		
		Blast-furnace blowing engines.	Converter blowing engines.	Electric generators.
Hagondage	6	Six 1,500 H.P. each	Two 5,000 H.P. each	Twelve 2,500 to 3,000 KW. each
Knutange..	10	Nine 2,000 H.P. each	Two 5,000 ,, ,,	Three 2,800 KW. each Two 1,100 ,, ,,
Rombas ..	6	Eight 2,000 H.P. each	One 6,000 ,, ,, Two 4,000 ,, ,,	Three 4,000 ,, ,,
Differdange	10	Eight 14,000 H.P. total	—	Twelve 20,000 KW. total
Adolf Emil Hütte ..	6	Eight 1,400m³. air capacity each	—	Nine 1,400 to 1,500 KW. each

Steam plant additional in all cases.

THE BRITISH ASSOCIATION.—V.

The Three-Electrode Thermionic Valve as A.C. Generator.

By Prof. C. L. Fortescue. (*Abstract.*)

Section G.—Engineering.

This paper deals mainly with work done during the war in the W/T Department of H.M. Signal School at Portsmouth, which constitutes the instructional and experimental centre for all matters pertaining to naval wireless telegraphy. The paper has been prepared in collaboration with the Superintendent of Signal Schools and his staff, has been submitted to the Admiralty, and is now published with the Board's approval.

Thermionic waves were used in the Naval Service for the generation of high-frequency currents of small amplitude for reception by the "heterodyne" or beat method in 1914. De

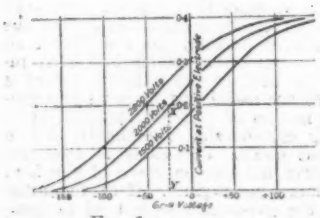


Fig. 1.

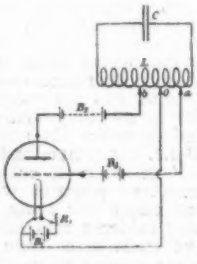


Fig. 2.

Forest's "audion" valves were used, and the circuits were made up from existing Naval Service apparatus. Later sets used for the same purpose were made by the Marconi Co., the valves employed being those designed by Capt. H. J. Round. In both cases the maximum high-frequency current was in the neighbourhood of 50 milliamperes.

During the spring of 1915 experiments were carried out with a transmitting valve of Capt. Round's design. At about this time the French too were experimenting with valve transmission. Towards the end of 1915 some transmitting valves of the "Oscillion" type were obtained from America by the Admiralty. But the uncertainty of the supply and the still far from perfect results obtained made it evident that the requirements of a Naval W/T set using transmitting valves could not yet be met. In the spring of 1916 a "Pliotron" valve, made by the American General Electric Co., was purchased by the Admiralty for experimental work. This valve but for one small defect was probably the equal of any valve made up to the end of 1918.

It was recognised that although the Pliotron valves as then developed could not be manufactured on a scale sufficiently large to meet naval requirements, and exhaustive trials and experiments were continued by the experimental W/T staff of H.M.S. *Vernon*. The results of these experiments together with the information already published in the technical and scientific journals (principally American) enabled a fairly complete theory of the action of both the circuits and the transmitting valves to be worked out. This theory has formed the basis of all the subsequent designs.

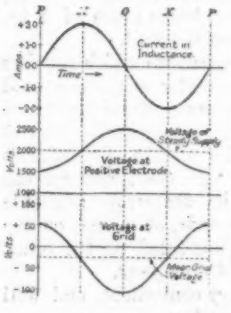


Fig. 3.

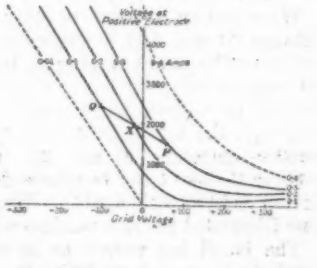


Fig. 4.

Early in 1917 the first attempts were made to manufacture transmitting valves in this country to meet naval requirements. This attempt was undertaken by the General Electric Co., at Hammersmith, in collaboration with the naval experimental W/T staff.

By a fortunate coincidence, the construction of these valves just preceded an urgent demand from the Grand Fleet for a valve transmitting set. The designs were worked out and eight sets were put in hand in the W/T workshops in H.M.S. *Vernon*. The first two of the sets were dispatched to the Grand Fleet on the night of Good Friday, 1917, within six weeks of the demand for the sets arising.

The success of the first valve transmitting sets in the Grand Fleet led quickly to the demand for other sets of great power. In the autumn of 1917 a larger set was designed to work from the power supply of existing spark apparatus. The apparatus was being fitted in ships as it became available

throughout the whole of the summer of last year. To a great measure the success of this set was due to the type of aerial-tuning inductance employed. This coil was designed by the W/T staff at Portsmouth primarily for use with Poulsen arc sets. Whilst the parts of this more powerful set were being manufactured, yet higher power sets were being experimented with for use on board ship and in the Admiralty shore stations.

Wireless telegraphy and telephony do not constitute the only spheres of utility of the three-electrode valve as an alternating-current generator. For laboratory and testing purposes it is rapidly taking the place of all other sources of A.C. where frequencies above about 200 cycles per second are required.

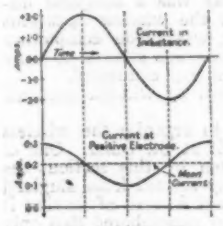


FIG. 5.

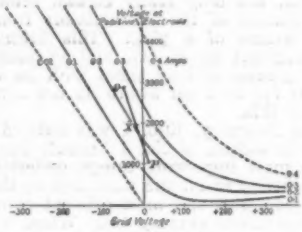


FIG. 6.

Characteristic curves showing the control exercised by the grid electrode are given in fig. 1, where the voltage of the grid with respect to the filament is plotted horizontally and the current at the positive electrode is plotted vertically for three different values of the steady positive voltage applied to that electrode. With the grid 100 volts or more negative to the filament, it is only with high voltage on the positive electrode that the current at this electrode is appreciable. As the grid becomes in turn less negative and then moderately positive, the current at the positive electrode gradually increases to a more or less clearly defined maximum value. This maximum value corresponds to the total rate at which the free electrons are emitted from the filament, and the hotter the filament is, the greater will be this rate of emission and the greater will be the maximum value of the current. After this maximum has been reached any further increase of the positive voltage of the grid will lead to a decrease of the current at the positive electrode because of the diversion of an appreciable proportion of the electron stream to the grid itself.

With bad proportioning of the circuit and the valve, the current generated may reach a stable maximum value long before the possible maximum power output from the tube is attained. Bad design of this kind leads to the use of unnecessarily large and expensive valves.

Referring to the simple circuit arrangement, fig. 2, in the course of one cycle of the oscillating current in the capacity-inductance circuit, the effective voltages both between the grid and the filament and between the positive electrode and the filament, are varying. In fig. 3 the variation of these two voltages is plotted for one cycle in the correct relative phases to the current in the inductance; the positive direction of the current in the inductance being from the point *a* to the point o, and on to the point *b* (fig. 2). With regard to the tube the positive directions for the voltages at both the

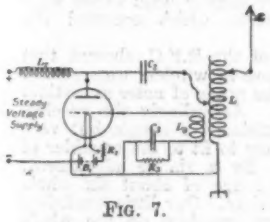


FIG. 7.

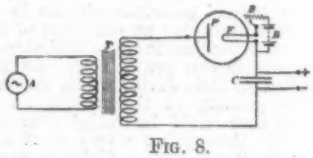


FIG. 8.

positive electrode and the grid is when the filament is negative. In order to determine the nature of the current in the part *ob* of the industance L it is necessary to refer to the characteristics of the valves. These may be plotted as in fig. 1, but are preferably drawn out as in fig. 4, adopted in H.M.S. *Vernon* in 1915, where the voltage at the grid is plotted horizontally, the voltage at the positive electrode vertically and the current at the positive electrode is drawn in as a series of contours of constant current.

The first point of the cycle of fig. 3 is a point where the voltage at the grid is a maximum and that at the positive electrode a minimum. This will correspond to a point P in fig. 4. After one quarter of a cycle has been passed through the voltage at both the grid and the positive electrode will be at the normal values as maintained by the batteries. This state corresponds to the point X of fig. 4 (which also corresponds to the point X, fig. 1). After one-half cycle has been passed through the point Q, fig. 4, will have been reached. After three-quarters of a cycle a return is made to the point X, and back again to the point P on completion of the whole cycle. Since the alternating components of the voltages in fig. 3 differ in phase by 180 deg., the points P, X and Q, fig. 4, will lie on a straight line, which has been called the "oscillation line." The way in which this line cuts the contours in fig. 4 shows the variation of the current in the part *ob* of the inductance L. This variation has been plotted in fig. 5 in its correct phase relation to the current in the inductance. It will be seen from an inspection of the second curves of figs. 3 and 5 that the alternating component of the current flowing in at o and out at *b* (fig. 2) is opposite in phase to the alternating component of the voltage between these two points. The conditions chosen for the diagrams represent, therefore, a supply of alternating power to the inductance. Had the oscillation line been drawn as in fig. 6, the phase of the current would have been reversed, and power would have been abstracted from the circuit. One condition necessary for the building up of a small incipient oscillation is, therefore, that the oscillation line should lie as in fig. 4, and not as in fig. 6.

The average current taken from the supply is $\frac{1}{2} I_c$ at the steady voltage V_o. Hence the efficiency of the valve, neglecting the power supply to the filament, is 50 per cent. This, however, is by no means the highest possible efficiency. Any arrangement of the valve and circuit that leads to an irregular wave of current giving a considerable power to the circuit but having at the same time a low arithmetic mean will give a much higher efficiency than 50 per cent. If a steady negative voltage is applied to the grid so that the midpoint of the cycle is towards the bottom of the characteristics, efficiencies as high as 75 per cent. can be obtained. A battery may be used for this purpose, but the circuit shown in fig. 7 is preferable, where the small rectified current from the grid passes through the resistance R, and so automatically maintains the grid at a negative voltage depending upon the amplitude of the oscillations.

Most of the valve-transmitting sets in the Naval Service have been designed to work as far as possible from the power supply of existing spark telegraphy sets, which supply is in the form of a H.T., single-phase, A.C., of frequency from about 100 cycles per second upwards. To use this supply it is necessary to fit rectifiers which will convert the A.C. into a D.C. supply. The rectifiers used are two electrode valves differing from the three electrode valves only in that the grid electrode is omitted. Fig. 8 shows a simple method of

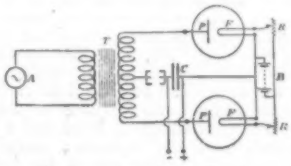


FIG. 9.

connecting up a two-electrode valve for this purpose. During the half-cycles when the positive electrode P is positive to the filament, negative electrons are drawn from the filament. During the other half-cycles no reverse current can pass. Consequently there is a deficit of negative electrons on the plates of the condenser connected to the filament of the valve. The terminals of the condenser C can then be used as a D.C. supply. By increasing sufficiently the capacity of the condenser the uniformity of the D.C. supply can be increased to any desired extent. An improvement involving the use of two valves is shown in fig. 9. With this system one valve is operative during each half-cycle and for a given uniformity of the D.C. supply, the capacity required in the condenser C is much less. The facts that the mid-points of the secondary windings of the spark set transformers were already connected to earth, and that the whole secondary voltage was usually in excess of that required for the valves, were additional reasons for the adoption of the two-valve system.

For the oscillating circuit, two systems have been used; one in which the aerial has constituted the capacity in the circuit, and the other an arrangement of coupled circuits, in which the aerial circuit is separately tuned and is loosely coupled to an oscillating circuit connected to the valve.

When using the aerial as the capacity, the circuit arrangement is as shown in fig. 7 with the addition of the necessary switch for the control of the oscillations in accordance with the Morse signals to be sent. This switch has to perform two functions, viz., to break the primary supply to the transformer and to throw the earth connection of the aerial coil over to the receiving instruments. Magnetically-operated switches have generally been used for this purpose which are controlled by the operator in the receiving compartment by a single Morse key of the ordinary type.

Wireless in the R.A.F. During the War.

By Major T. Vincent Smith, M.C., M.I.E.E., R.A.F.

(Abstract.)

Section A.—Mathematical and Physical Science.

It is only by realising the insignificant amount of data existing at the outbreak of war that the details of the development of aircraft wireless assume a correct perspective. Only one machine of those which went with the original Expeditionary Force was fitted with wireless. The earliest

form of spark transmitter we used was an accumulator battery and closed oscillating circuit, the inductance of which was common to the closed and radiating circuits in the form of the well-known auto transformer. A wandering plug enabled the closed circuit to be tuned to the aerial, or the aerial could be brought into resonance with the closed circuit by lengthening or shortening. A somewhat similar set, made by Leslie Miller, had an inductive coupling; another squadron was using a French engine-driven set, having the auto-transformer coupling and a multiple rotary spark gap. The power and weight of these three sets were respectively: 40 watts, 50 lb.; 100 watts, 65 lb.; and 150 watts, 78 lb.

The ground receiving arrangements consisted of an eight-section, 30-ft. tubular steel mast, a 150-ft. silicon-bronze wire aerial, a rather unwieldy tuner, and two kinds of crystal detectors, also two pairs of Brown high-resistance telephones. Two copper gauze mats as counter-capacity completed the outfit. The tuner was eventually replaced by a good and efficient instrument.

The first battle in which wireless became a serious factor was that of Festubert in May, 1915. The preparations for this battle consisted of observing for the artillery whilst it registered guns. It is also memorable as being the first occasion upon which machines were specially detailed to observe the battle and to report progress by wireless. This work was done by No. 16 Squadron, under Major Holt, with four machines fitted with Leslie Miller transmitters. Foundations were thus laid which resulted in the development of that very important branch of aerial activity known as the close contact patrol for the purpose of reporting infantry movements.

Another squadron, No. 10, had now been added to the wing, and apart from ordinary troubles, jamming or mutual interference, steadily increased, but the experience gained by this time enabled one to begin reform and organisation in real earnest, and the first thing done was to standardise the apparatus. Both for its light weight and simplicity the No. 1 transmitter was chosen and gave immediate relief from jamming owing to the smaller power used by it. The effect of eliminating powerful signals was very marked and the simplification through having only one kind of transmitter materially added to reliability. So much was this the case that all machines in the wing, amounting to 48 in all, were ordered to be fitted. The wave lengths were redistributed on the following plan: The three flights of the most northerly squadron were given 100, 180, and 260 metres, the next squadron was given 140, 220, and 300 metres, and so on alternately down the line. The beneficial effect of this change was sufficient to meet the large increase in machines.

The transmitter was now taken in hand and a lot of useless connections removed, and the radiating circuit altered by disconnecting the aerial from the top of the inductance and attaching it to a wandering plug, thus enabling the aerial to be loosely or tightly coupled as required. The component parts were assembled in a neat gas-tight box and the inductance calibrated in wave lengths, thus reducing the weight of the whole set to 26 lb. including all fittings, and its bulk by one-half. A further addition of 24 machines was made to our wing. These naturally brought more trouble in their wake as we now had 72 machines fitted.

To relieve the severe pressure I tried reducing still more the power of the No. 1 transmitter which was done with almost startling results.

The battery was cut down to three cells and the adjustment of the spark gap and primary make-and-break very carefully attended to, with the result that the rasping gutteral splutter gave place to a pleasing flute-like note. The effect was truly gratifying; not only were the operators delighted at the change, but jamming lost many of its terrors. Owing to the power being reduced to 20 watts, the trembler and spark gap remained clean and in adjustment for a longer time and the weight of the battery was also reduced. It was found that the trembler could be made to vary its note within small limits by careful adjustment. This was of great assistance to the operators and the soundness of these principles in the prevention of jamming was amply proved later on.

About this time another very important detail was added to our organisation in the establishment of a squadron wireless control station situated between the guns and the squadron. It was connected to squadron and batteries by telephone, and its prime duty was to listen to the machines working with their batteries and to take down as much as possible. These records formed an invaluable means of locating causes of failure, as the control station afforded definite proof of the truth or otherwise of reported faults. Another duty was to lay out a signal on the ground indicating to a machine on its way from the squadron to the lines, the quality of its signals. The control station was naturally freer from jamming than a battery station, consequently it was possible to accept signals from a machine and telephone them to a battery that was for some reason not getting its signals. The first of these stations was started at Vielle Chapelle in May, 1915.

In July the first introduction of the thermionic valve took place. It was a Round valve, of the soft type associated with the Round magnifying circuit, and was very delicate in action, requiring considerable training on the part of the operator, but it obviously possessed great possibilities.

The battle of Loos, in September was a great opportunity for proving the use of wireless on a large scale, and it emerged triumphant. In spite of there being about 20 machines always working in the salient to about 60 ground stations with the guns, no serious failure took place.

About this time another small but effective improvement was made. Large capacity accumulators were conductive to failures owing to the mechanics forgetting when they were last charged. By substituting accumulators of sufficient capacity for only one spell they had of necessity to be recharged after every flight, and in addition the weight of the battery was reduced by 25 per cent., and the whole transmitting set including all fittings to 18¾ lb.

A matter that demanded earnest attention was the danger from fire. Obviously the close association of the electric spark and petrol required that every possible precaution should be taken. As a switch might easily be moved in the case of a crash, the only really certain remedy was a complete disconnection of the accumulators from the wireless apparatus by means of a plug. This fitting was made compulsory throughout the R.F.C., and no machine was allowed to leave the ground or land again with its battery connected.

So far as I am aware no fire caused by wireless occurred after this.

In February, 1916, I was ordered to organise the wireless repair section of No. 1 Aircraft Depôt at St. Omer. One of the most important things undertaken by this section was the fitting of all the machines as they arrived from England in the safest and most efficient manner instead of leaving it to squadrons to carry out. When it is remembered that only 20 watts were being used by the transmitters, the greatest care had to be taken to avoid leakage by conduction and induction.

The transmitter and its battery were mounted on a tray which slid into a little cupboard in the fuselage. In the early days, officers were taught to adjust and tune in the air, but experience showed that it was much safer and better to leave all that sort of thing to be done by the trained mechanics on the ground; they were responsible that everything was in perfect order before the machine left the ground.

The confidence of the pilots was a very important factor in the success of wireless, and to gain this, one had had to participate in, and appreciate, as far as possible, some of their difficulties and dangers. This knowledge profoundly modifies the design of any apparatus that can be used in war successfully. To call upon a pilot to make even one adjustment may easily add 20 per cent. to the failures, and it was found by experience to be far better to sacrifice a certain amount of electrical efficiency and to provide apparatus which was able to do the work required.

These remarks are made in defence of the No. 1 transmitter and in answer to the criticism by wireless engineers who had no opportunity of appreciating the conditions under which this work was carried out on the Western Front.

Early in 1916 Major Prince brought out a valve transmitter with telephonic attachment of his own design. This was successfully demonstrated to Lord Kitchener, who was visiting France at the time. He was able to hear every word from a machine flying 40 miles away, and was much impressed.

Whilst the correct length of aerial for a definite length of wave is well known for different kinds of aerials on the ground, I found the ratio in the air differed with each type of machine, and presumably depended upon their different electrical capacities. The ratio of 1 ft. of aerial for a wave of one metre was true only within small limits.

Amongst the requirements for the following year the need for a 100-mile transmitter was felt. Major Whiddington's spark transmitter was adapted provisionally until valves were sufficiently developed for this work, which occurred the following year.

Although the continual growth of the R.F.C. showed that the general principles already in use in wireless were sound, it was clear that an extension of the range of notes as distinct from wave lengths was desirable. Accordingly the wireless repair section set to work and produced a simple but very effective little device which was easy to fit to the trembler of the primary of the transmitter. By a simple adjustment, the note could be varied over a range of about six whole tones, thus giving a very great variety. Our little workshop made them, and a flight in every squadron on the whole front was fitted in a month, and proved a great success.

In March, 1916, it became necessary to turn our attention seriously to the reception of signals in aeroplanes. The instruments hitherto sent out for trial had not proved satisfactory, and it was reported that the enemy was using such a device. With the assistance of Col. Blandy, three days later we were able to give a demonstration of the reception of signals from a standard army station, by an aeroplane at 20 miles range. We used three valves associated with fixed coupled circuits designed for one wave length only. This made for extreme simplicity, as the apparatus only required to be switched on to function without further adjustment.

The whole front was by now standardised and organised. As the Somme operations took place during July, August, and September, when the days were very long, the strain on the operators of listening in from dawn to dusk was immense, especially as there were over 600 ground stations in the battle area with only one operator at each. The arrangements for putting the guns on to fleeting targets worked splendidly, and over 100 signals an hour of this kind were dealt with at Group Headquarters. Co-operation with the infantry also proved successful.

At the end of 1916 the total wireless personnel numbered

200 officers and 2,000 operators and mechanics, or more than the total personnel of the R.F.C. at the outbreak of war.

It was probably in training that the greatest effect was made. Specialisation was carried to its extreme, and with standardised apparatus and methods, the system proved itself fully justified, and an ever increasing stream of officers and men poured out to France, all highly trained in their own particular branch of wireless, whilst periodical visits were paid to the Front by us all in order to keep thoroughly up to date.

Extremely good wireless work was done at the battle of Arras and Vimy Ridge.

During the year continuous wave transmission and wireless telephony were developed to the point of standardisation and use at the Front. In the latter case intercommunication between the fighting machines in the air was leading to important results, and a range of five to ten miles was achieved. The visual reception of signals in aeroplanes utilising valves to work a relay was developed and demonstrated successfully in France by Capt. Murphy, but was not employed. By the end of 1917 the following apparatus had been evolved for and by the R.F.C., and was in use in the field: Short and medium range air to ground spark transmitter; aircraft receiver for Morse and telephony; aircraft and ground telephony and C.W. transmitter; ground spark tonic train and C.W. transmitters and C.W. and spark receivers, and directional receiving for aircraft was in an advanced experimental stage.

The total wireless personnel now numbered 300 officers and 3,760 operators and mechanics.

At the signing of the armistice complete ground wireless communications had been established between all units. Between 400 and 500 machines were fitted with wireless, and the guns were provided with nearly 2,000 wireless stations. The whole personnel amounted to 520 officers and 6,200 other ranks.

It must, I think, be judged satisfactory that we were able to beat the enemy so thoroughly in a science in which at the outbreak of war they excelled so conspicuously. Of the truth of this assertion he has given us ample corroboration in a document captured by us.

Electric Resistance Heat-treating Furnace.—Two forms of a new type of electric resistance furnace have been developed by the General Electric Co., U.S.A., viz., a high-temperature (1,000 deg. C.) furnace used in tempering and hardening gun forgings, and a low-temperature furnace (up to 510 deg. C.) used for shrinking jackets on a variety of cores. According to the *Technical Review*, the furnace is built in units which may be fitted above one another to give a greater depth of heating surface. Each unit of the low temperature furnace consists of a cylindrical casing with top and bottom castings and a heating unit of calorite ribbon mounted on, but insulated from, a cast-iron supporting plate. A one-section furnace is usually provided with automatic control. The construction of the vertical high temperature furnace involves the use of a heavy calorite ribbon supported on insulators embedded in the furnace wall of refractory bricks, so as to eliminate the inherent weakness of metal supports at high temperatures. Each section is controlled independently and automatically. The advantages claimed for this type of furnace include minimum temperature variation, uniform and maximum rate of heating, and the elimination of scale due to oxidation.

The Electrical Conductivity of Salt Vapours.—According to G. C. Schmidt, *Mitteilungen des Reichsbundes Deutsche Technik*, the vapours or the volatile halogen salts of cadmium, zinc, ammonium, iron, and aluminium are good conductors of electricity even at relatively low temperatures, whereas the vapours of the halogen salts of mercury, tin, antimony, arsenic, and iodine and other organic substances are insulators. The experiments show that the conductivity increases with time until a maximum is obtained and then falls to a constant value. Further tests, however, show that even at very high temperatures the conductivity of salt vapours is independent of time provided there is sufficient surface-constancy. The apparent inconstancy is caused by the fact that the vapours can only pass into the measuring-chamber gradually and later on the salts get caked together, thus reducing the surface and the rate of evaporation. The vapour density and ionisation also decrease.—*Technical Review.*

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Engine Crankshafts.

Although it is now 55 years since H. C. Sorby, of Sheffield, began the systematic study of metals under the microscope, engineers as a class unfortunately do not avail themselves directly of the valuable results that the new science has yielded. The article in your issue dated September 19th, however, must constitute as remarkable a case of lack of familiarity with the principles of the subject as could well be found. There is much in the article that could be challenged, but I will concern myself only with the two important and quite erroneous statements, (*a*) that only by making an engine crankshaft inordinately big can it be made to resist fatigue indefinitely, and (*b*) that steel undergoes deterioration under reversals of stress even though no fracture develops.

Before it is possible to form an idea of the phenomenon of fatigue failure it is necessary to have some knowledge of the microstructure of the metal. Like all metals, steel is crystalline, and in an average oil-hardened carbon steel shaft the crystals have an average diameter of about 0.002 in. Externally the crystals are irregular in shape, due to mutual interference as the crystals form, but internally they are quite symmetrical, and consist of a great number of tiny cubes arranged on one another in perfect order. Where two crystals meet there is between them a film of non-oriented molecules

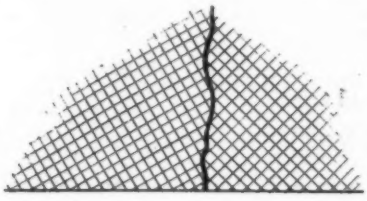


Fig. 1.—Unstressed.

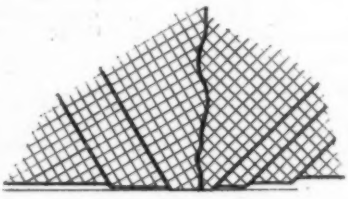


Fig. 2.—Tension.

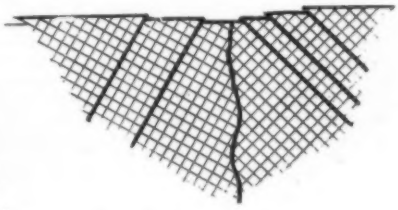


Fig. 3.—Compression.

The Behaviour of Steel Crystals under Stress.

in the state of an under-cooled liquid that constitutes a hard unyielding cement binding the crystals together. In a normal metal this amorphous cement-like material is considerably stronger than the crystals themselves, and however the metal may be broken, the path of rupture is always through the crystals and not along the crystal boundaries.

If steel is stressed within the elastic limit, then by definition, when the load is removed the metal resumes exactly its original shape. It follows that in such circumstances there is no permanent change whatever in the metal, and consequently there can be no deterioration. For failure by fatigue to be possible, it is necessary for the elastic limit to be exceeded, but for the yield point not to be reached. In other words, there must be local deformation but no general yield of the metal. The yield point can be found readily by means of a tensile test, but the real elastic limit can be found only by the tedious process of making a series of Wöhler tests. In general, the real elastic limit of a good steel is of the order of 70 per cent. to 80 per cent. of the yield-point stress.

The formation and development of a fatigue flaw is really very fascinating to the student of metallography. Fig. 1 shows portions of two crystals at the surface of the lower side of a shaft. The irregular vertical line represents the strong cement-like material between the crystals, and the small squares on the crystals indicate the minute cubes of which they are composed. The two crystals selected are amongst those that in consequence of size and the inclination of the cleavage planes to the direction of the applied stress are the worst circumstanced and undergo deformation when the stress is applied. Fig. 2 shows the manner in which the crystals deform. It will be seen that there has been no yielding of the inter-crystalline cement, and that the deformation is due to the minute cubes of the crystal slipping on one another, which action may take place in one plane or in a number of parallel planes. According to the researches of Sir G. T. Beilby, this slipping along the cleavage planes causes molecules to be detached from the surfaces of the cubes that solidify into a strong cement similar to that between the crystals. Thus the action of deforming a crystal actually strengthens it, and so to break steel requires a greater stress than was necessary to cause the yield. If the stress were now maintained constantly, the steel would safely carry it, under the conditions postulated, for an indefinitely long period. As the shaft rotates, however, the two crystals are carried round to the upper side, and the stress changes from tension to compression. The two crystals now deform in the reverse way, as shown in fig. 3, the slipping on the cleavage planes being facilitated due to the non-oriented molecules not having had time to solidify fully and therefore being in a mobile state. In this compressive deformation more material is detached from the tiny cubes, and as the shaft rotates the action continues until the crystals become exhausted and finally fail. The same process then begins in the adjoining

crystals on to which additional duty is now thrown, and in time they fail similarly. In this way a fatigue flaw is started that slowly travels through the shaft.

Such a failure is the only fatigue that is known, and your contributor is quite wrong in stating that there is a fatigue that is not accompanied by a creeping flaw. If after twenty years' running a shaft is entirely free from flaws, there is the strongest possible proof that the stress is within the elastic limit of the material, and the shaft can then be expected to last for an indefinitely long period. If a short time after the examination the shaft should fail, then either there was an undetected flaw or else there has been an important increase of stress that might have been caused in a variety of ways. One of the most fruitful causes of crankshaft failures in internal-combustion engines and high-speed steam engines has been the action of the frequency of the natural torsional vibrations of the shaft approximating to that of the fundamental engine impulse. In such cases, merely to increase the shaft diameter, as your contributor suggests, is just as likely to increase as to diminish the trouble. The way to avoid crankshaft failures is (*a*) to make sure that there is no chance of resonance between shaft vibration and engine impulse, (*b*) to see that the *maximum* stress is well within the elastic limit of the material, and (*c*) to use an alloy steel with which the ratio of elastic limit to ultimate strength is high. To design a crankshaft that will endure for an indefinitely long period does not call for excessive cost, but for the intelligent application of existing knowledge on the subject of stress distribution and steel composition and heat treatment.

Your contributor's idea of a general deterioration of steel without a flaw developing recalls the old notion that steel is a "fibrous" material that under certain conditions of vibration or loading is apt to become "crystalline." The misapprehension arose from the great difference that the broken surfaces present according to the manner of breaking. In an ordinary tensile test the crystals are slowly drawn out by yielding along the cleavage planes and the jagged ends of the distorted crystals give the fractured surfaces the appearance known as fibrous. If the same piece of steel were broken with a hammer blow, the fractured surfaces would have the appearance known as crystalline, for the reason that there would be insufficient time for the crystals to be distorted, and they would part more or less cleanly, according to the rapidity with which the fracture was caused. Almost invariably, steel fails in service from shock or fatigue, and with such failures the fractured surfaces present such an entirely different appearance from those of the original test pieces that it is wrongly thought that there has been some change in the steel itself.

In the hardened state, steel is in a meta-stable condition, but the microscopic examination of ancient steel shows that in the course of centuries there is no observable change. Provided, therefore, that steel is not deformed or unduly heated, it can be regarded as being perfectly stable so far as the requirements of engineering are concerned.

G. F. Barclay, Ph.D., M.Inst.C.E.

Sale, Cheshire, *September 30th*, 1919.

TRADE STATISTICS OF SOUTH AFRICA.

The following statement, showing the imports of electrical and similar goods into the Union of South Africa during the year 1918, has been taken from the recently-issued official trade statistics. The figures for 1917 are added for purposes of comparison, and notes of any increases or decreases are given :—

	1917. £	1918. £	Inc. or Dec. £
Asbestos manufactures.—			
From Great Britain ...	4,000	2,000	– 2,000
„ Other countries ...	1,000	1,000	—
Total	5,000	3,000	– 2,000
Brass manufactures.—			
From Great Britain ...	17,000	12,000	– 5,000
„ United States ...	2,000	3,000	+ 1,000
„ India	1,000	—	– 1,000
„ Japan	2,000	10,000	+ 8,000
„ Other countries ...	1,000	1,000	—
Total	23,000	26,000	+ 3,000
Copper, plate and sheet.—			
From Great Britain ...	1,000	—	– 1,000
„ United States ...	1,000	5,000	+ 4,000
Total	2,000	5,000	+ 3,000
Copper manufactures.—			
From Great Britain ...	1,000	—	– 1,000
„ United States ...	3,000	2,000	– 1,000
„ Other countries ...	1,000	2,000*	+ 1,000
Total	5,000	4,000	– 1,000

* Japan £2,000.

	1917. £	1918. £	Inc. or Dec. £
Electrical cable and wire.—			
From Great Britain ...	42,000	20,000	– 22,000
„ Italy	1,000	—	– 1,000
„ United States ...	10,000	32,000	+ 22,000
„ Other countries ...	1,000	38,000*	+ 37,000
Total	54,000	90,000	+ 36,000

* Japan £34,000.

Electrical fittings, including posts.—			
From Great Britain ...	110,000	81,000	– 29,000
„ Canada	1,000	1,000	—
„ Holland	24,000	95,000	+ 71,000
„ United States ...	61,000	79,000	+ 18,000
„ Japan	6,000	24,000	+ 18,000
„ Other countries ...	5,000	2,000	– 3,000
Total	207,000	282,000	+ 75,000
Lamps and lampware.—			
From Great Britain ...	11,000	10,000	– 1,000
„ United States ...	15,000	13,000	– 2,000
„ Sweden	5,000	1,000	– 4,000
„ Other countries ...	1,000	8,000*	+ 7,000
Total	32,000	32,000	—
Electrical machinery.—			
From Great Britain ...	82,000	56,000	– 26,000
„ Sweden	7,000	—	– 7,000
„ United States ...	61,000	69,000	+ 8,000
„ Other countries ...	—	1,000	+ 1,000
Total	150,000	126,000	– 24,000
Cranes, elevators, and lifts.—			
From Great Britain ...	6,000	8,000	+ 2,000
„ United States ...	1,000	3,000	+ 2,000
Total	7,000	11,000	+ 4,000
Mining machinery.—			
From Great Britain ...	461,000	292,000	– 169,000
„ Sweden	2,000	4,000	+ 2,000
„ United States ...	244,000	272,000	+ 28,000
„ Canada	3,500	—	– 3,500
„ Other countries ...	500	1,000	+ 500
Total	711,000	569,000	– 142,000
Machinery not specially mentioned (other than agricultural, manufacturing, &c.).—			
From Great Britain ...	174,000	122,000	– 52,000
„ Sweden	6,000	5,000	– 1,000
„ United States ...	57,000	76,000	+ 19,000
„ Canada	6,000	13,000	+ 7,000
„ Other countries ...	1,000	5,000	+ 4,000
Total	244,000	221,000	– 23,000
Telegraph and telephone material.—			
From Great Britain ...	6,000	2,000	– 4,000
„ Sweden	1,000	3,000	+ 2,000
„ Other countries ...	—	1,000	+ 1,000
Total	7,000	6,000	– 1,000
Tramway rails.			
From Great Britain ...	—	1,000	+ 1,000
„ United States ...	4,000	—	– 4,000
Total	4,000	1,000	– 3,000
Tramway rolling-stock.			
From Great Britain ...	2,000	4,000	+ 2,000
„ United States ...	1,000	3,000	+ 2,000
„ Other countries ...	—	—	—
Total	3,000	7,000	+ 4,000
Other tramway materials.—			
From Great Britain ...	1,000	—	– 1,000
„ United States ...	1,000	1,000	—
„ Other countries ...	1,000*	—	– 1,000
Total	3,000	1,000	– 2,000

* Madagascar (sleepers) £1,000.

In addition to the above the following goods were imported as "Government stores" :—

Brassware.—			
From United Kingdom ...	1,000	—	– 1,000
Copper, plate and sheet.—			
From United Kingdom ...	4,000	10,000	+ 6,000

	1917.	1918.	Inc. or Dec.
	£	£	£
Electrical cable and wire.—			
From United Kingdom ...	24,000	11,000	– 13,000
,, Canada	—	3,000	+ 3,000
Total ...	24,000	14,000	– 10,000
Electric fittings.—			
From United Kingdom ...	6,000	5,000	– 1,000
,, Other countries ...	2,000	1,000	– 1,000
Total	8,000	6,000	– 2,000
Lampware.—			
From United Kingdom ...	2,000	2,000	—
Cranes and elevators.—			
From United Kingdom ...	3,000	6,000	+ 3,000
Electrical machinery.—			
From United Kingdom ...	2,000	1,000	– 1,000
Other machinery.—			
From United Kingdom ...	17,000	10,000	– 7,000
,, Other countries ...	3,000	6,000	+ 3,000
Total	20,000	16,000	– 4,000
Telegraph and telephone material.—			
From United Kingdom ...	13,000	9,000	– 4,000
,, Sweden	19,000	4,000	– 15,000
,, Other countries ...	3,000*	—	– 3,000
Total	35,000	13,000	– 22,000

* United States

INDUSTRIAL LEGISLATION.

By JOS. J. H. STANSFIELD, F.C.I.S.

A FEW years ago the average business man engaged in the electrical industry did not, except perhaps on the political side, concern himself greatly with the legislation of the year.

Times have changed, however; for several years a number of Acts have been passed each Session with which it has been necessary to become acquainted, and the Parliamentary Session which has just come to an end is no exception to the rule.

Amongst the Acts passed the following are of interest:—

Coal Industry Commission Act.—An Act passed to constitute a Commission to inquire into the position of and conditions prevailing in the coal industry. The electrical industry, like all manufacturers, is greatly concerned with the action which has followed or may follow the various Reports. It is common knowledge that the price of coal has already been increased, and this has been one of the causes of the increased cost of electricity and of goods made by electrical manufacturers.

Increase of Rent and Mortgage Interest (Restrictions) Act, 1919.—This Act amends the principal Act passed in 1915, which now continues in force until Lady Day, 1921, subject to certain modifications.

The principal Act provided that rents could not be increased except at a rate not exceeding 6 per cent. per annum on any amount expended on capital account since the commencement of the war, or to meet increases of rates where these were payable by the landlord. An increase of 10 per cent. in the standard rent is now permitted, "standard rent" meaning the rent at August 3rd, 1914, or if not let at that date the last rent paid before or the first rent paid after that date, or where the house is let at a progressive rent the maximum rent payable.

In the principal Act it was also provided that mortgage interest might not be increased unless notice demanding repayment of the mortgage or increased interest had been given prior to August 4th, 1914, but under the new Act an increase may be made up to one half per cent. subject to the rate after the increase not exceeding 5 per cent.

The Act of 1915 only applied to houses of comparatively low rents. The new Act increases the limits from April 2nd, 1919, in London from £35 to £70, in Scotland from £30 to £60, and in the provinces (including Ireland) from £26 to £52.

One of the reasons for the passing of the Act in 1915 was to give security to tenants, but that Act provided that the Court might make an order for ejectment if the premises were reasonably required by the landlord for his own occupation or by some person in his employ or in the employ of a tenant. This caused considerable hardship in many cases, as houses were bought over the heads of the tenants and notice was then given in order that the houses might be occupied by the purchasers.

The Increase of Rent, &c. (Amendment) Act, 1918, put an end to this by restricting an application to the Court to a landlord who had purchased or otherwise acquired the premises not later than September 30th, 1917, but it is now provided that nothing in this Act of 1918 shall prevent the Court making an order after considering all the circumstances, including especially the alternative accommodation available for the tenant.

Wages (Temporary Regulation) Extension Act, 1919.—In 1918 an Act was passed prescribing minimum rates of wages during the six months following November 21st, 1918, where directed by an award of a court of arbitration or in accordance with an agreement or settlement approved by the Minister of Labour. This Act has now been extended for a further period of six months, that is, until November 21st, 1919.

Disabled Men (Facilities for Employment) Act.—This Act is to enable arrangements to be made by the Treasury to relieve employers from increased expenditure in respect of workmen's compensation where such increase is due to the provision of compensation or damages in respect of accidents to or the industrial disease of men who have served in His Majesty's Forces during the war and who are in receipt of a pension in consequence of injury or disease attributable to or aggravated by such war service.

Statement of Rates Act.—It is now necessary for every document containing a demand for rent or receipt for rent which includes any sum for rates paid or payable by the owner to state either the annual, half-yearly, quarterly, monthly or weekly amount of such rates in accordance with the last demand received by the owner from the rating authorities. This Act is of especial importance, there being a liability to penalty in case of default.

Finance Act.—Income Tax.—The difficulties of the law relating to income tax have been in the past increased by the necessity to refer to a large number of Acts passed over a long period of years. To a large extent this difficulty was relieved by the passing of the Finance Act, 1918, which consolidated the various Acts, and in the Act passed during the past session it has, as a rule, been only necessary to refer to the Act of 1918.

Several sections of the Act of last year are continued in force with respect to reduced rates applicable to service pay, relief in respect of diminution of profits due to the war, or where the actual income falls short of the assessed income by more than 10 per cent. or in respect of Colonial income tax.

Incomes from wounds or disability pensions are to be exempt from both income and super-tax for 1918-9 and any succeeding year of assessment, and certain war gratuities are also exempt as from August 4th, 1914, from both of these taxes.

The recent allowance in respect of mills, factories, &c., of one-sixth the annual value of the premises, in addition to the net assessment, as a deduction in arriving at the liability for tax, instead of deducting the net assessment only, is now extended to premises situate outside the United Kingdom.

In the Income Tax Act, 1918, Rule 8 of No. V. in

Schedule A confers relief in respect of the cost of maintenance, repairs, insurance and management of houses where, over an average of five years, it has exceeded the usual allowance of one-sixth in respect of houses and one-eighth in respect of land, but the relief was restricted to £12 assessments. It is now provided that the relief shall extend to annual values under Schedule A of £70 in London, £60 in Scotland, and £52 elsewhere.

A certain relief has been granted in past years in respect of colonial income tax and excess profits duty. It is now enacted that this relief shall extend to any territory under His Majesty's protection, this giving a somewhat wider meaning to the expression "any British possession."

The Income Tax Act, 1919, deals with certain duties of, and amendments in, the law relating to Customs and inland revenue, including excise, and makes provision with respect to rates of income tax and excess profits duty, but these are general to all persons and industries, and to deal adequately with them a considerable amount of space would be required. It may, however, be stated that the income tax is continued at 6s. in the £ with certain reductions and abatements for moderate incomes, super-tax is unaltered, and excess profits duty is reduced from 80 per cent. to 40 per cent.

BUSINESS NOTES.

Danish Cable Works Extension.—The directors of the A.S. Nordiske Kabel og Traadfabriker, of Copenhagen, whose share capital was increased in 1915 from £164,000 to £274,000, have decided to make a further augumentation to £548,000, and the new shares have just been offered for subscription at par. At the recent meeting when the proposal to raise the additional capital was sanctioned, it was explained that the company's activity had considerably developed in recent years, necessitating extensions of the plant in order to deal with both the home and the export demand. The company was formed in 1898 with a capital of £41,000, and several increases have taken place in the meantime.

American Electrical Exports.—The *Electrical Review* (Chicago) states that astounding figures on the growth of American electrical export trade are disclosed in the monthly summary of the foreign commerce of the United States for last June, just issued by the Bureau of Foreign and Domestic Commerce, Washington, D.C. Electrical shipments for that month totalled over 100 per cent. above those of the corresponding month last year, and nearly 40 per cent. over the preceding monthly record established last March. The figures for June also complete the data for the fiscal year ended June 30th, for which the extraordinary sum of over $80,700,000 was reported, this being nearly 48 per cent. over the preceding fiscal year, and more than 34 per cent. above the highest 12 months—the calendar year 1918, whose total was $59,982,526. All these figures would be still higher if they included electric locomotives; the latter are separately listed in the Government reports; during the fiscal year these were shipped to the value of $327,947. In the following table are given the comparative figures for last June, for June of 1918, and for the fiscal years ended June 30th, 1919, and June 30th, 1918 :—

Articles.	June		Fiscal year	
	1919.	1918.	1919.	1918.
Batteries	$787,748	$272,316	$4,800,668	$3,351,838
Carbons	173,583	117,995	1,672,106	1,525,128
Dynamos or generators	760,546	133,549	4,269,103	2,688,169
Fans	130,817	164,486	1,297,017	818,338
Heating and cooking apparatus	192,551	49,185	1,292,886	583,988
Insulated wire and cables	1,420,699	340,138	8,683,304	5,730,766
Interior wiring supplies, including fixtures	280,631	138,805	1,926,177	1,592,809
Lamps—				
Arc	173	90	14,555	13,308
Carbon-filament	5,276	3,985	166,394	144,761
Metal-filament	590,085	475,768	4,465,075	3,182,516
Magnetos, spark plugs, &c.	219,826	167,710	3,020,610	3,167,925
Meters and measuring instruments	319,386	208,294	2,618,405	1,592,195
Motors	1,562,521	521,442	10,677,354	6,598,664
Rheostats and controllers	65,384	24,170	434,413	212,059
Switches and accessories	503,975	188,408	2,633,227	2,229,023
Telegraph apparatus, including wireless	92,230	11,659	765,011	294,297
Telephones	377,395	274,809	3,135,851	2,566,929
Transformers	488,483	464,195	4,423,007	2,343,968
All other	3,039,569	1,462,515	24,487,147	16,021,380
Total	$10,990,717	$5,019,519	$80,712,310	$54,546,961

In the following table are given the monthly totals of electrical shipments from the United States during the 12 months of the fiscal year ended June 30th, 1919. This table shows that November, January, February, March, and June, in turn, broke all preceding monthly records. These monthly figures also show that the extraordinary total for the fiscal year is due chiefly to the decided impetus to the foreign electrical trade since the signing of the armistice on November 11th, 1918 :—

Month.	Electrical exports.	Month.	Electrical exports.
July, 1918	$5,393,949	January, 1919	$6,722,524
August, 1918	5,340,110	February, 1919	7,566,089
September, 1918	5,146,077	March, 1919	7,876,353
October, 1918	4,860,392	April, 1919	7,709,138
November, 1918	6,177,252	May, 1919	7,717,518
December, 1918	5,187,981	June, 1919	10,990,717

The following table gives the totals for the last seven fiscal years :—

Fiscal year.	Electrical exports.	Fiscal year.	Electrical exports.
1912-13	$26,772,816	1916-17	$51,903,823
1913-14	25,060,844	1917-18	54,546,961
1914-15	19,771,757	1918-19	80,712,310
1915-16	30,254,020		

This last table shows the effect of the world-wide depression just before the breaking out of the World War, followed by the worse depression during its first year up to about the beginning of 1916, when both neutrals and belligerents began turning to the United States for their electrical supplies, since which time there has been a steady growth of U.S. foreign electrical shipment, especially since active fighting ceased last November.

Australia and Enemy Goods.—The Board of Trade announces in its *Journal* that the Governor-General of the Commonwealth of Australia has telegraphed, stating that the Commonwealth Government is unable to modify its present policy towards enemy goods containing more than 5 per cent. of German or Austrian origin, which have been, are, and will be, prohibited from entry into the Commonwealth. Prohibited goods landed in Australia will be liable to immediate forfeiture.

A French Trade Bank to be Established.—A Bill which is before the French Chamber of Deputies approves the creation of a Trade Bank to provide financial facilities for the export trade. The long credits essential in commercial transactions with buyers in foreign countries, particularly in Latin-America, and also the Far East and in certain countries of the Levant, have operated against French exporters, who have not had the same facilities in this respect as the shippers of other countries, and to this fact is attributed in great part the relatively poor position of the French export trade. The proposed French National Bank of Foreign Commerce will have an initial capital of 100,000,000 fr.; it will possess an organisation for the development of long-term credit business abroad, and will also collect information likely to be of service in connection therewith and to exporters. According to the *Board of Trade Journal* it will establish branches, agencies and connections abroad to work in co-operation with the central organisation at home, and a special reserve fund will be formed for this purpose from money, including an annual subsidy, provided by the State.

Catalogues and Lists.—The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Leaflet relating to the Pirelli-General cable works at Southampton, where cables, wires and flexibles are being manufactured. The change-over from war to peace conditions was rapidly effected, and in consequence immediate deliveries of the above manufactures can be given.

Messrs. Siemens Bros. Dynamo Works, Ltd., Palace Place Mansions, Kensington Court, London, W. 8.—Publication No. G47 contains a full and imposing list of rolling mills where the company have installed, or are in course of installing, the electric drive, aggregating 200,000 h.p. A brief section relating to reversing mill equipments is followed by one of six pages tabulating particulars of continuous rolling mill equipments. The name of the mill, output, type, and speed of motor, type of mill, diameter of rolls, speed, and other particulars are tabulated.

The Bastian Electric Co., Ltd., 185, Wardour Street, London, W. 1.—Leaflet No. 10/11, describing and illustrating the Bastian hot-water tank for day and night service. The matter will be of interest in connection with new housing schemes.

Enterprise Manufacturing Co., Ltd., Gun Street Electrical Works, Bishopsgate, London, E. 1.—Illustrated price leaflet relating to Universal electric fans, small motors, and grinders.

The Sun Electrical Co., Ltd., 57-59, Neal Street, Long Acre, London, W.C. 2.—New list of eight pages describing and giving prices of their electric sign flashers—a branch of business which is developing now that the war, with many of its restrictions, is past. All the firm's Thermo types of flasher can be delivered from stock. All "Sunco" flashers, both Thermo and motor-driven, are manufactured at the company's own works in Neal Street. Other features of the list are automatic time-switches and Sun signs.

Messrs. Mansell & Ogan, Ltd., 15-17, Cecil Court, Charing Cross Road, London, W.C. 2.—Illustrated circular giving prices of half-watt flood lanterns for stage lighting, and "Cecil" dimmers.

Electrical Catalogues Wanted for Savona.—We read in the *Board of Trade Journal* that the British Vice-Consul at Savona states that he is prepared to receive, for the use of applicants at the Vice-Consulate, priced catalogues of cast-iron "U"-shaped joints for boilers (fresh water and low-pressure steam); Diesel and Petters oil engines; and motors for alternating and continuous current. Catalogues should be provided with notes showing the terms for the supply of these goods c.i.f. Savona or Genoa. Catalogues should be sent direct to the British Vice-Consul at Savona.

American Electrical Exhibitions. — The New York Electrical Exposition was opened in Grand Central Palace, New York City, on September 24th, and remained open until October 4th. The features include a modern electrically-equipped home, and a complete electric vehicle exhibit, including passenger and commercial cars, small industrial trucks and electric automobile accessories.

The Chicago Electrical Show is to be held at the Coliseum, Chicago, from October 11th to 25th, and a house-wiring campaign is to be conducted in the city during the coming winter. In the latter connection, members of the Illinois Electrical Contractors' Association recently met in Chicago, together with representatives of the Commonwealth Edison Co. and of the Electrical Inspection Department of the city, for the purpose of arranging plans for "an intensive campaign" to wire existing buildings during the coming winter, and to work out a solution to some of the problems encountered in such work. Due to labour difficulties that have risen in Chicago, construction work in that city has been practically at a standstill, and, with the cold weather coming on, it is not probable that it will be resumed to any extent until spring. In order to provide work for the electricians, therefore, it was decided to urge the local electrical contractors to exert every effort they possibly could toward securing a large number of old house-wiring contracts during the winter period. The difficulties encountered in conducting the old house-wiring business in Chicago were discussed. According to our contemporary, the principal difficulty seems to be in getting the buildings connected after the wiring is completed. In order to overcome this the electrician, contractor, central station, and the inspector must co-operate very closely to avoid any unnecessary delay. Several plans have already been developed to accomplish this, but to date these have only been successful in a small degree. As a result of the meeting referred to, however, steps are to be taken by the various factors in the industry which will undoubtedly result in the elimination of such delays.

Book Notices.—*Faraday House Journal.* Vol. VIII, No. 4. Michaelmas Term, 1919. London: Faraday House.—This number, besides the usual supply of notes of interest to students, contains an account of the F.H.O.S.A. Annual Dinner held in June last, another of the Principal's interesting little articles, this time on the "Temperature Coefficient of Copper," and some observations on electric heating. Mr. A. S. Cross, who, by the way, is an old Faradian, gives a short account of the electrical installation at Gretna Green munition factory, a detailed account of which we published some months ago.

We have received a copy of the first number of the *Henley Telegraph*, a quarterly staff magazine issued by W. T. Henley's Telegraph Works Co., Ltd., of Blomfield Street, London Wall, E.C. 2. The editor is to be congratulated upon the interesting character of the general contents, mostly written in lighter vein. On the serious side there are Staff Notes, Social Club Notes, references to recent Henley contracts, sports news (accompanied with pictures of a football match played at Gravesend last month), and a summary showing the part played by Henley men in the war, and the honours gained.

Beama Journal (Spanish edition). Vol. III, No. 3. September, 1919. London: King's House, Kingsway, W.C.

"The Manufacture of Chemicals by Electrolysis." By A. J. Hale. Pp. xi + 80; 10 figs. London: Constable & Co. Price 6s. net.

Journal of the Franklin Institute. Vol. CLXXXVIII, No. 3. September, 1919. The Institute: Pennsylvania, Pa. 50 cents.

Osram "Atmos" Half-watt Lamps: Price Reduction. —The General Electric Co., Ltd., of 67, Queen Victoria Street, E.C. 4, informs us that on October 1st the list-prices of half-watt type (gas-filled) lamps were reduced as follows:—

Rating in watts.	Reduced From	To	Rating in watts.	Reduced. From	To
15	4s. 6d.	4s. 3d.	300 L.V.	25s. 0d.	20s. 0d.
30	5s. 6d.	5s. 0d.	300 H.V.	30s. 0d.	20s. 0d.
60	6s. 6d.	5s. 6d.	500	30s. 0d.	24s. 0d.
100	12s. 6d.	10s. 6d.	1,000	40s. 0d.	30s. 0d.
150	16s. 6d.	13s. 6d.	1,500	50s. 0d.	37s. 6d.
200	20s. 0d.	16s. 0d.			

Outstanding orders will be executed at reduced prices.

It will be seen that the reductions vary from a few pence in the case of the smallest lamps to 25 per cent. in the case of the larger ones, and 33⅓ per cent. in one instance.

The smallest lamp suitable for running on circuits at 200 volts and over is rated at 100 watts, on which a reduction of 16 per cent. has been made, while the 300-watt high-voltage lamp is one-third cheaper—a very important economy, in view of the suitability of this lamp for the illumination of large rooms, shops, &c. The changes are embodied in a new price-list issued last week-end. The reductions will be cordially welcomed; it is gratifying to see them in these days of soaring prices, and we hope that the example will prove contagious.

Electrical Wages at Bradford.—The local branch of the Electrical Trades Union are making an application for an increase in wages of £2 3s. 1d. per week above the rates now prevailing. The present wages are 120 per cent. above the rate paid before the war. The Masters' Association are considering the matter. If the application is successful, the members of the Union in Bradford will be receiving nearly £6 per week.

American Exports of Electrical Goods. — In the statistics given on pp. 444 and 445 of last week's issue of the Electrical Review, showing the exports of electrical goods from the United States, owing to pressure and dislocation caused by the strike, the totals of the various classes of goods shipped in 1916-17 to "Other Countries" were incompletely shown.

It should be noted that the correct figures are as follows:—

Exports of—	Dollars. 1916-17.
Telegraph instruments—	
To other countries	130,000
Telephone instruments—	
To other countries	398,000
Other electrical instruments and appliances—	
To other countries	2,769,000
Gas engines, stationary—	
To other countries	226,000
Electric motors—	
To other countries	652,000
Arc lamps—	
To other countries	11,000
Metal filament lamps—	
To other countries	386,000
Carbon filament lamps—	
To other countries	9,000
Insulated wire and cables—	
To other countries	2,038,000
Static transformers—	
To other countries	238,000
Steam engines, stationary—	
To other countries	151,000
Electric locomotives—	
To other countries	35,000
Dynamos and generators—	
To other countries	586,000
Fans—	
To other countries	91,000

Football.—On Saturday last, in Barking Park, the Sterling Athletic (who are connected with the Dagenham Works of the Sterling Telephone and Electric Co., Ltd.) won the first Cup match played by the club, defeating the Barking Athletic, a strong local side, by three goals to one, in the London Junior Cup Competition.

French Electrical Companies.—Among newly-formed companies are the following:—Etablissements Astral, electric and other kinds of lighting and heating, 200,000 fr.; headquarters, Paris. Etablissements Luchaire, electric lighting and heating material, 4,000,000 fr., Paris. Le Fil Isolé, insulating material, 320,000 fr., Paris. Mounin, Guillard et Jaloustre, instruments of precision, 300,000 fr., Paris.

New Italian Companies.—Servizi Pubblici e Trazione Meccanica nell'Alto Milanese e dell'Alto Novarese is the style of a company founded to improve the communications between the province of Milan and Novara, Como and Pavia. The company is owing to the initiative of Engineer Giampiero Clerici, with the help of manufacturers in the zones interested, among whom is Commendatore Gianfranco Tosi. The capital of the concern is fixed at 1,000,000 lire.

Under the title of the Società Dino Samaia e Fratello a company has been formed at Milan to carry on the business of agents and consulting electrical engineers.

At Rome the Società Elettrica del Velino has been established, with a capital of 1,000,000 lire, for the erection and working of electric undertakings.

Export Activities of the American General Electric.— According to a statement made by one of the directors of the General Electric Co. (U.S.A.), as published in the American *Electrical Review*, that company through its new subsidiary (£4,000,000), already referred to in these pages, is planning to make a strenuous bid for foreign business:—

"The departure of President Swope for Europe lends colour to the belief that announcement of interest to the electrical trade may be expected within a short time. The General Electric Co. has grouped all of its foreign possessions into one corporation, the International General Electric, of which $10,000,000 is 7 per cent. cumulative preferred and $10,000,000 common. All of this stock is reported to be in the treasury of the company."

Government Sales.—No. 9 of *Surplus*, the official publication of the Disposal Board, Ministry of Munitions, contains particulars of a good deal of electrical plant and machinery, electric cranes and other dock equipment, electrical stores and instruments, factory stores, &c.

The Strike and the Lyons Fair.—*The Times* correspondent at Lyons telegraphing on October 1st, the date of the official opening of the Lyons Fair, states that throughout the whole Fair there was an atmosphere of general unpreparedness, due in part, no doubt, to the prevailing bad state of the railway transport. "Among the foreign exhibitors the British are not foremost, in fact, only three large British firms had their stands arranged with sufficient conspicuousness to attract general notice. Of these, only one had been really completely fitted up. Many of the other 23 had not even their name-plates up. Among the other foreign exhibitors perhaps the most prepared were the Swiss and the Italians."

The Board of Trade Urge Local Authorities to Buy British-Made Goods.—The Deptford Borough Council reports having received a letter from the Industries and Manufactures Department of the Board of Trade referring to the recent declarations of the Government as to the present economic position of the country, and suggesting for the consideration of the Council the desirability of stipulating so far as practicable that in all contracts placed by local authorities the goods to be supplied shall be of United Kingdom manufacture. The Board of Trade also add that where the prices quoted by British manufacturers are unduly high as compared with those quoted by foreign tenderers, or where an unduly long period is required for delivery, the Board would be glad to be so informed and would be prepared to make inquiries into the matter.

Liquidation.—Haslam & Stretton (Bristol), Ltd.—We are informed that the voluntary liquidation of this company does not in any way affect the parent company of Haslam and Stretton, Ltd., of Cardiff, Bristol and Swansea. The company now in liquidation was formed in 1916 as a subsidiary company to take over the agency of the Herbert Frood Co., Ltd., for the sale of "Ferodo" brake linings. A new arrangement has now been entered into between Haslam & Stretton, Ltd., and the Herbert Frood Co., Ltd., which renders the company—Haslam & Stretton (Bristol), Ltd.—inoperative, and this is the sole reason of the liquidation. Messrs. Haslam & Stretton, Ltd., will still retain the agency of the Herbert Frood Co., Ltd., in so far as it relates to collieries and works.

Trade Announcement. — Messrs. Vickers, Ltd., engineers, Barrow-in-Furness, are opening a depôt at Glasgow, to enable them to fulfil Scotch orders.

Auction Sale.—The Assets Auctions Co., Ltd., will sell by auction, on October 15th, at 119-121, Newington Causeway, S.E., a quantity of electrical fittings, half-watt lamps, &c. See our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Aberystwyth.—Proposed Sale.—The Urban E.L. Co. has refused the offer of the T.C. to purchase the E.L. undertaking for £23,000, but it is understood that negotiations are still proceeding.

Barnstaple.—Shipyard Supply.—The T.C. has entered into an agreement with the British Construction Co., and Shapland and Petter, Ltd., for a supply of electricity to the shipyards.

Bedwellty.—Proposed Loan.—The U.D.C. has referred back to the E.L. Committee a recommendation to raise a loan of £5,000 for the lighting of Aberbargoed and Pengam, and the appointment of Mr. Fletcher as consulting engineer.

Blackburn.—Year's Working.—The annual accounts for the year ended March 25th, 1919, show a total income of £70,493, total expenditure, £53,595, gross profit, £16,898. £19,124 was relegated to the sinking fund and payment of interest; the balance-sheet shows a net loss of £2,226, against a net profit of £4,472 for year 1917-18. Total revenue increased by £2,115; units generated decreased by 1,140,731 to 9,177,686; private lighting decreased by 152,583 units, or 13·8 per cent., and power by 1,429,247 units, or 21 per cent. The traction supply showed a slight increase. Motors representing 231·5 B.H.P. were connected to the mains. Consumers increased by 138 to 4,411. With regard to the manufacture of munitions, the total number of 6-in., 4·5-in., and 3·3-in. H.E. shells handled was 344,257, and the weight 9,500 tons. Machines numbering 38, and motors aggregating 146 H.P. were installed, and the amount of electricity consumed in the factory up to the end of 1918, was 1,540,000 units. Total profit was £23,864, £15,538 being paid in relief of the rates.

Blackpool.—Coal Shortage.—The E.C. has issued a warning against the excessive use of electricity for power or lighting, owing to the scarcity of coal.

Bolton.—Loan.—With reference to the application for sanction to borrow £150,000 for extensions at the Back-o'-th'-Bank generating station, the M.H. approves generally of the T.C.'s proposals, but will defer issuing formal sanction to a loan until estimates based on provisionally-accepted tenders have been submitted to the Ministry.

Bootle (Cumberland).—E.L. Scheme.—The D.C. is to ask the Whitehaven T.C. if it proposes to extend new electricity mains to the district, as the Council does not wish to have a supply from Barrow-in-Furness T.C., which, it is stated, proposes to utilise the water power from the River Esk.

Burley-in-Wharfedale.—E.L. Scheme.—Some time ago negotiations took place between the local District Council and one of the large monopolist electric supply companies in the West Riding, with respect to the village being electrically lighted, as a cable has now been extended to Otley (a few miles away), but the negotiations proved abortive by reason of a difference as to whether the supply should be in bulk through the Council (as it is with gas) or through the company direct. The question has been reopened, and inquiries are being made with a view to ascertaining whether the company has modified its attitude.

Burnley.—Year's Working.—The annual accounts for the year ended March 31st, 1919, show a total income of £42,402, an increase of £4,968. A sum of £14,515 was used for paying interest and sinking-fund charges. The net profit was £1,490, a decrease of £2,455. Total units sold numbered 2,223,478, a decrease of 119,268; private lighting, 815,715, against 889,822; power, 1,269,243, against 1,316,830; heating and cooking, 130,917, against 129,364; public lighting, 7,603, against 6,730; traction, 3,504,893, against 3,355,786. The load factor was 25·59 per cent., against 26·51 per cent. Coal consumption increased by 965 to 9,611 tons. Maximum load on feeders was 2,555 KW. Motors connected increased from 457 (2,260 H.P.) to 521 (2,771·25 H.P.) and consumers increased by 101 to 2,137.

Proposed Extensions.—It has been decided to extend the main in Todmorden Road for 314 yards, at a cost of £314.

A Sub-Committee has been appointed to consider the report of Mr. E. M. Lacy on the proposed extension of the electricity undertaking.

Bury.—Accident.—Owing to a breakdown at the electricity works at Chamber Hall, electricity was cut off for an hour, and the Heywood tramway service was stopped.

Canterbury.—Area Extension.—The T.C. has applied to the B. of T. and the R.D.C. for consent to supply electricity to premises outside the city limits.

Continental.—Sweden.—Quite a large number of new companies have recently been formed in Sweden in connection with electric lighting and power distribution undertakings. Among them are the Idre Elektriska Kraft and Belsynings A.B., at Idre; the Bole Elektriska A.B., Sundsvall; the Halinas Elektriska Kraft A.B., Halinas; the Nilsbole Elektriska Kraft A.B., Loning; the Hofva Elektriska A.B., Hofva; the Forenade Elektriska A.B., Ludyika; the Hadanbergs Elektriska A.B., Hadanberg; and the Bjurholms Elektriska A.B., Bjurholm.

Germany.—All factories, tramways, &c., throughout the Rhine Palatinate are at a standstill, the supply of electricity having been suspended owing to lack of coal.

Dewsbury.—A recommendation that application be made for sanction to expend £83,000 on electricity works extensions has been withdrawn on the ground that there is need for some importan tinformation to be obtained before the Council could arrive at a decision. The withdrawal was agreed to, despite a protest that local industries were being held up for want of sufficient electrical power.

East Ham.—Year's Working.—It is proposed that the deficiency on the E.L. undertaking of £9,173 be partly met by the sum of £8,000 already provided in the estimate of the general district rate, and that the balance of £1,173 be included in the revised estimate of rate for the year ending March 31st, 1920.

Elland.—New Station.—The electricity works are regarded as unsatisfactory from the point of view of cost, and the Council is seeking a site for a new generating station. A Sub-Committee has been appointed to make inquiries in regard to two sites which have been offered.

Erith.—Price Increase.—The U.D.C. has increased the price of electricity for lighting and power by 1d. per unit as from October 1st. The arrangement for a supply at fixed prices is to be determined, and such consumers charged at the ordinary lighting rates, large power consumers being given the option of entering into agreements on the same terms as those taking a supply under contract, viz., £3 16s. per KW. per annum, plus ¼d. per unit, which has been increased during the war by 20 per cent.

Farnham.—Price Increase.—Hindhead Electricity Co. is applying for an order to increase the charges for electricity to enable it to pay a dividend of 4½ per cent., three-quarters of the pre-war dividend.

Halifax.—Prov. Order.—It is proposed to apply to the B. of T. in the session 1920 for a prov. order to authorise the Corporation to supply electricity for all purposes within the whole of the U.D. of Luddenden Foot.

India. — Cauvery Hydro-Electric Scheme. — The Cauvery hydro-electric installation was the forerunner of such schemes in India, or, indeed, in the East; the original object was the supply of electricity to the goldfields at Kolar, 92 miles from the power station. Energy is also transmitted to Bangalore. The first installation was completed in 1902. The Government of Mysore has now sanctioned a sixth installation, estimated to cost Rs. 32,92,000, which is made up as follows:—Rs. 11,48,081 for replacing the 11 small turbines reported to be obsolete, and Rs. 21,43,919 for rearranging and extending the capacity of the plant from 22,650 to 30,600. There are at present 15 units in the generating station, with a capacity of 22,660 H.P. The power actually generated is, however, 21,500 H.P., as one unit of 1,150 H.P. is kept in reserve. The aggregate demand on the generating station during the year 1917-18 was 19,230 H.P. The mining companies on the Kolar goldfield have notified that the power supply to them should be further increased by 2,500 H.P. They also require an additional block of 3,200 H.P. for hoisting purposes and for intermittent power supply. Another 2,000 H.P. is required for industrial purposes in Bangalore and Mysore cities. The total demand in the immediate future is,

therefore, expected to increase to 27,000 H.P. The cost of reconstructing the 11 turbines and of duplicating bus-bars, including the extension of the step-up transformer house, is estimated at Rs. 13,63,400. Another important feature of the scheme is to shift the transformer station from the head of the bluff, where it is now situated, and reconstruct it at the foot as an extension of the present generating station. This is calculated to result not only in better efficiency, but also in facilitating the economical maintenance of the plant. After the completion of the first stage of the Krishnarajasagara Dam, the calculated minimum flow available in the river during the summer months is 750 cusecs. The extension now proposed is, therefore, limited to 27,000 H.P. net. With the second stage of the reservoir the minimum flow available at Sivasamudram Falls will be 900 cusecs. It will then be possible to generate 32,000 H.P. The proposed work is so arranged that further additions can be undertaken at any time without material alteration.—*Times of India.*

Inverness.—The Harbour Trustees are to obtain an estimate from the E.L. Co. for electricity for lighting and power at the harbour.

Isle of Wight.—Price Increase.—The E.L. & P. Co. has advanced the charge for electricity for heating to 3½d. per unit, from the quarter ending December next. The charge for supplies by slot meters and the weekly payment system will also be increased, and the rentals of all meters advanced by 1s. per quarter.

Kettering.—New Plant.—Application is to be made for sanction to borrow £38,000 for installing the following plant:—1,500-KW. turbine, driving D.C. dynamo through gearing, with condensing plant, switchgear, cooling tower, and pipe work; steam turbine-driven feed pump; a 30,000-lb. boiler, with mechanical stokers and high-pressure economiser; the work to be done as soon as possible.

Leyton.—Price Increase.—Charges for electricity have been increased by a further 50 per cent., from the commencement of the Christmas quarter. This brings the advance over pre-war prices to 100 per cent.

Lincoln.—Year's Working.—The annual report for the year ending March 31st, 1919, shows gross profit of £7,331, an increase of £1,228, from which service of department, interest, &c., £5,423 was met, leaving a net profit of £1,908, an increase of £1,250. Total revenue was £25,079, an increase of £3,274, and working expenses were £17,703, an increase of £2,052. Capital expenditure during the year was £6,011. The output was 2,770,339 units, a decrease of 13·5 per cent. as follows:—Private lighting, 600,873 units, 9,506 decrease; public lighting, 4,627 units, 3,321 increase; power, 1,905,968 units, 10,330 increase; Messrs. Clayton & Shuttleworth, 67,554 units, 444,691 decrease; traction, 191,317 units, 7,008 increase. The whole of the decrease is accounted for by Messrs. Clayton & Shuttleworth.

Liverpool.—Loan Sanction.—The Corporation has secured sanction to borrow the following amounts for the purpose of the electricity undertaking:—£67,845 for mains; £4,000 for switchgear; £48,000 for boilers, economisers, and transforming plant.

London.—Price Increase.—At a meeting of the City Corporation last week, Mr. Underwood said that the action of the Streets Committee in opposing the application of the Charing Cross, West End, and City Electricity Supply Co. for power to increase its charges from 5d. to 8d. per unit had been successful. The company had been limited to a penny increase on 5d.

Islington.—The price of electricity has been increased a further 20 per cent.

Nelson and Colne.—Bulk Supply.—The Councils have recommended the acceptance of a joint agreement for the supply of energy by Nelson to Colne Corporation on terms and conditions to be agreed upon. The town clerks and electrical engineers of the two towns are to prepare a report of rates and charges for further discussion.

Paisley.—New Sub-Station.—A new sub-station is to be erected in Sneddon Street, for the Corporation.

Plymouth.—Street Lighting.—In view of the Government restrictions, the provision of about 600 additional street lamps during the winter months is not to be proceeded with.

Rochdale.—Bulk Supply.—The E.C. reports the necessity for making provision to meet large forthcoming demands for energy. The whole of the bulk supply to be provided by the Lancashire E.P. Co. is already absorbed. The chairman and manager are ascertaining what steps the Government proposes to take under the new Electric Power (Supply) Bill as regards the district, and meanwhile the Lancashire E.P. Co. is being asked its terms for a further bulk supply of approximately 5,000 KW.

Salford.—Loan.—Application is to be made to the M.H. for sanction to borrow £120,000 to cover the cost of Messrs. J. Diggle & Son's scheme for new electrical pumping plant, screening chambers, detritus tanks, and other appurtenant works at the sewage works.

Service Costs.—In future a proportion of the cost of laying a sub-service cable to a consumer's premises, representing a length of 5 yards, is to be borne by the Corporation. Subject to certain conditions, consumers who paid the cost of services laid during the war are to be refunded a proportion of such cost in order to place them on the same basis as consumers under the above conditions.

Southport.—Strike.—On Friday night members of the local branch of the E.T.U. decided to strike, as the result, it is stated, of the introduction of voluntary workers in their department.

South Shields.—The E.C. has been notified by the Jarrow and District Electric Traction Co. that the directors note that the Council cannot consent to the company obtaining its supply of electricity in the South Shields area from the County of Durham E.P.S. Co., as the Council is prepared to supply electricity for this purpose on reasonable terms. The company, as the present system of supply from the Council is very unsatisfactory, inquires what steps the Council is prepared to take to remedy this, and what its terms for this supply will be.

St. Anne's-on-the-Sea.—Year's Working.—The annual accounts for year ended March 31st, 1919, show a total revenue of £22,722, compared with £21,221 for the previous year. The total expenditure was £18,989, compared with £17,507, leaving a gross profit of £3,733. The number of units sold was 1,560,749, a decrease of 17·7 per cent. Units sold for public lighting numbered 86,379; by contract (traction), 469,060; private lighting, 299,005½; power and domestic, 706,305. Number of consumers was 2,017, an increase of 75; the year's surplus on the munitions account was £1,253.

Stalybridge.—Price Increase.—Stalybridge, Hyde, Mossley, and Dukinfield Joint Tramways and Electricity Board has decided to increase the cotton-mill scale of charges for energy from 20 to 30 per cent.

Sunderland.—Accident.—The electricity supply completely failed for over an hour on the 29th ult., by the failure of the governor gear on a new 7,500-KW. turbo-generator which is being installed at the Hylton Road works. The new generator is still in the hands of the constructing contractors, and had been carrying the load satisfactorily for about 24 hours before the breakdown. The old plant had to be brought into operation while the new machinery was being put in order again.

Wallesley.—Price Increase.—The T.C. has been recommended to increase the price of electricity for lighting from 5d. to 5½d. per unit, and for heating and cooking from 2½d. to 2¾d.

Walthamstow.—Loan Sanction.—The M.H. has sanctioned the borrowing of £2,437, £2,348, and £1,837 for over expenditure, mains, and services, and approves generally of the proposals for the installation of additional plant, but proposes to defer issuing formal sanctions to loans for this purpose until prices based upon provisionally accepted tenders are submitted.

Coal Consumption.—A return has been received from the B. of T. (Coal Mines Department) with respect to the consumption of coal in the electricity undertaking, compared with other undertakings of a similar size throughout the country, the figures showing that for the year ended March 31st, 1918, the pounds of fuel consumed per unit generated was 2·81, with a thermal efficiency of 10·12, whilst for the year ended March 31st, 1919, the fuel consumed was 2·77 lb., with a thermal efficiency of 10·72. In the group of 114 stations throughout the whole country, in which Walthamstow is included, Walthamstow is in the third place, whilst in the group of 34 stations situated in the Metropolitan area, Walthamstow occupies the first place.

TRAMWAY AND RAILWAY NOTES.

Accrington.—Parcels Service.—A report on the working of the tramways parcels department shows an adverse balance in consequence of the increased wages and war bonus of the staff; charges have been increased.

Birkenhead.—Year's Working.—The accounts for the year ending March 31st, 1919, show an income of £114,974, an increase of £17,137; working expenses, £69,249; profit, £45,725, £29,225 of which was relegated to sinking fund, income-tax, &c. The available balance of £16,500 was partly used in aid of the rates, the rest being relegated to the reserve and renewal funds. The total number of passengers numbered 23,942,837, an increase of 3,404,361; total number of units used, 2,812,760, against 2,708,495. The parcels traffic revenue was £196, against £206. The feeder cables from the generating station to Conway Street, and from the generating station to Borough Road, which during the past three years have been giving considerable trouble, have been replaced by new cables of larger capacity, and an additional cable has been laid from the generating station to Claughton Road. The work was carried out by Messrs. W. T. Henley's Telegraph Works, Ltd., at a cost of £4,899, less the scrap value of the old cable. In March, 1919, an order was placed with Messrs. The B.T.H. Co., Rugby, for 12 car sets of electrical equipments, with 35-H.P. new type ventilated motors, at a cost of £490 10s. per car set. These form the first instalment towards replacing the existing type 25-H.P. motors. A commencement has also been made towards the replacement of some of the worn-out Peckham type of truck, 10 new trucks of the Brill type having been ordered.

The motor-bus service, powers for which were obtained in July, 1914, could not be inaugurated during the war. An order was placed as soon as possible, after the signing of the Armistice w

Messrs. Leyland Motors, Ltd., for 10 'buses, and delivery has now been commenced. A service, between Rock Ferry and Moreton, has been instituted, and other services will be run to the surrounding districts.

The collections on the cars for war charities ceased at the end of January, 1919, after being carried on for three years. The following total amount was realised, £6,874. In addition to ordinary repairs, the following work has been carried out during the year :—110 wheels re-tired, 44 broken axles replaced, 1,298 yards trolley wire renewed, 6,120 yards guard and suspension wire renewed.

Blackpool.—Coal Shortage.—Apart from the railway strike, there is a great shortage of coal, and the Sunday service of Corporation tramcars has been suspended until further notice, whilst the week-day service has been cut down by one-half.

Bradford.—New Cars.—A new tramcar of the closed-in kind was put into use on the Greengates section, last week. It has been constructed at the Thornbury car shed, and specially adapted to go under a very low railway bridge on the route. Hitherto only open-deck cars have been used on this section.

China.—New Tramway.—A concession for the construction of a tramway system in Canton has been granted to a syndicate composed of two British subjects and one Chinese.

Continental.—Belgium.—The Brussels tramway men were to call a strike for Monday last. The companies were willing to consider demands for higher wages if increased fares were authorised, but the Inter-Communal Tramways Commission has refused this permission.

Dartford.—Time Extension.—The B. of T. has granted one year's extension of time to Balfour, Beatty & Co., for the construction of the tramway between the terminus at Stone, and the commencement of the Gravesend system.

Ilford.—New Cars.—The cost of new cars is reported to be £2,016 each, compared with £700 before the war. The new cars, however, are of improved type, and will carry more passengers.

Lincoln.—Year's Working.—The annual report on the working of the Corporation tramway department for the year ending March 31st, 1919, shows gross profit of £5,806, an increase of £1,312, from which services of debt and war service allowances, £2,677, have been met, leaving a net profit of £3,236, an increase of £1,376, to transfer to depreciation account. Working expenses increased by 30 per cent. to £8,280. Passengers carried numbered 2,581,030 ; passenger traffic increased by 21 per cent., and workmen's traffic by 9 per cent. In a few months' time the G.B. stud system of working the cars will be abandoned. The permanent way has had to be largely neglected, and during the current year some systematic re-paving will have to be undertaken. When the overhead system is completed, the iron stud heads of the G.B. equipment will be removed, but the underground conduit will be left in its present state.

London.—For Monday's meeting of the L.C.C., reports down for consideration from the Highways Committee, which at present has before it a number of schemes for linking up the present tramway termini and extending the system, include the following :—(*a*) That the Government be asked to set up forthwith an independent body to consider the full scheme of tramway development projected by the Council, and to hear any objections that may be raised to such scheme by the local authorities, and that such body be empowered to make such modifications in the scheme as it may think fit after hearing the evidence submitted to it by those concerned ; (*b*) That it be referred to the Parliamentary Committee to take the necessary steps to obtain the suspension of the Standing Orders of Parliament so as to provide in respect of tramway schemes to be introduced in the session of 1920 that the Council shall be enabled to place such schemes before Parliament for consideration, notwithstanding the fact that it may not have secured all the requisite consents of the local and road authorities under standing orders to the introduction of the necessary Bill ; (*c*) That the Minister of Transport be asked to receive a deputation from the Council in support of the proposals contained in the foregoing resolutions.

With regard to auxiliary omnibus services the Committee recommends :—"That notice be given by public advertisement of the intention of the Council to consider at its meeting on October 21st a proposal that it shall take the necessary measures for promoting in the session of Parliament of 1920 legislation to enable the Council to own omnibuses, and to run in, and in the vicinity of, the County of London auxiliary omnibus services for the linking up of tramway dead-ends and for other specific purposes, and to defray out of the county fund the cost and expenses of so doing."

Accident.—The whole of the L.C.C. system was stopped at 10 a.m. on the 1st inst., for 30 minutes, due to a mishap to a boiler at the Greenwich generating station.

Two L.C.C. tramway cars collided on Friday last at the junction of Lambeth Road and St. George's Road, and delayed the service.

Mexico.—The Mexico Tramways Co. announces that, owing to its being impossible to complete construction of the tramway between the City of Mexico and Puebla, an arrangement has been made by which the time-limit has been extended for 6½ years.

Nelson.—Loan.—The T.C. has, owing to the dangerous condition of the present building, applied for a loan of £25,000 for the erection of a new car shed.

Peru.—Strike.—A strike of electrical employés completely stopped the Lima Light and Power Co.'s tramways on Saturday. Employés of commercial houses threatened to strike also.

Southport.—Year's Working.—The accounts for the year ended March 31st, 1919, show a total revenue of £53,492 ; expenditure, £33,144 ; gross profit, £20,348, of which £5,066 was relegated to the sinking fund ; £2,100 was handed over in aid of the rates, and the net profit of £505 was placed to the appropriation account. Passengers carried numbered 8,842,687, the electricity used totalling 728,530 units.

Sunderland.—Extension.—The Tramways Committee is recommending the T.C. to agree to the construction of a single loop line in the centre of the town in order to relieve the present congestion in Fawcett Street. The new loop would be *via* High Street, John Street, and St. Thomas Street.

United States.—Railway Electrification.—The Chicago, Milwaukee, and St. Paul Railroad is about to inaugurate another 110 miles of electrified line from Othello to Cle Elum, Wash., including a crossing of the Columbia River. By January 1st the remaining 135-mile stretch of the line from Harlowton, Mont, to Settle, will be completely electrified, 885 miles in all, or within 200 miles of half the entire length of the St. Paul-Settle line. The last stretch from Cle Elum to Settle, 130 miles, will cost from 25 per cent. to 40 per cent. more, relatively, than the preceding sections.

Battery Locomotives.—For conveying shells through the various processes and for hauling chemicals at Edgewood Arsenal, Baltimore, the U.S. poison-gas factory, some eight miles of narrow-gauge railway were laid, 16-lb. rails being used, laid to a 21'5-in. outside gauge. The cars were four-wheeled, ball-bearing, outside-flanged, and 15 battery locomotives furnished the necessary power ; loads of 100 tons were frequently hauled by a single locomotive. The maximum gradient did not exceed 2 per cent. Signals were arranged, and trains were operated night and day.—*Tech. Rev.*

York.—Loan.—The Tramway Committee recommends plication for a loan of £3,200 for a site on which to erect a new car-shed.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—The increasing volume of commercial traffic over the lines of the Eastern and Associated Telegraph Companies, since the signing of Peace, is causing heavy congestion and delay to telegrams. The companies appeal to the public to refrain from using cables except for messages of the most urgent importance, and also, in their own interests, to curtail the length of telegrams as much as possible.

France.—All restrictions regarding the exchange of telegraphic correspondence in France have been suppressed. Telegraph offices will now accept telegrams under pre-war conditions.

A director of the British Chamber of Commerce at Paris has undertaken to make "personal representation" to the authorities in London about the unsatisfactory conditions of the postal, telegraph, and telephone services between England and France.

Holland.—The Dutch Government expresses its willingness to grant the telegraph and telephone employés an increase of wages as from July 1st, but a strike, nevertheless, is still possible.

North Sea Cable.—Direct cable communication between Copenhagen and England was re-established on Tuesday. Since Saturday afternoon messages had had to be sent through Sweden.

Telephone Service.—A reply has been received by the York City Council with respect to the recent complaints of the inadequacy and unsatisfactory condition of the telephone service between York and Leeds, in which the Postmaster-General states that the delays have been consequent upon the war conditions. It is now proposed, however, to install a new combined exchange in the Post Office in place of the three exchanges now operating there ; the type of switchboard has not yet been definitely decided. A new cable is also to be laid between the two cities, and arrangements are being made in Leeds for the betterment of long-distance calls. A new switchboard is being installed in the present local exchange in order to effect an improvement in the local and junction services. The Estates Committee, in reply, has strongly urged the importance and advantages which attach to the adoption of the automatic telephone system in the city.

Wireless Communication.—The Air Ministry makes the following announcement :—Wireless communication has now been established between the civilian aerodromes at Hounslow (London) and Le Bourget (Paris). Messages can be transmitted between 6.45 a.m. and 7 p.m., Greenwich time. Wireless communication on this route is only available for "Air Service messages"—viz., messages regarding the arrival and departure of aircraft, weather reports, and urgent messages asking for assistance, &c. Messages of a private or personal nature will not be transmitted. Information as to the handing in and delivery of messages, &c., can be obtained from the Civil Aviation Traffic Officers at the aerodromes.

The Ministry of Shipping announces that arrangements have now been made for intercommunication by wireless telegraph between ships while in ports of the United Kingdom. Shipowners may therefore communicate by wireless telegraphy with their ships in their own or other ports employing any of their ships lying in the owners' port for this purpose.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia. — SYDNEY.—December 19th. Metropolitan Board of Water Supply & Sewerage. Centrifugal pumps, electric motors, &c., for the low-level pumping station, Marrickville. Offices of the Board, 341, Pitt Street, Sydney.*

MELBOURNE. — P.M.G.'s Department. January 20th, 1920. Automatic telephone switchboard at Collingwood. Schedule 1,583. (September 19th.)

December 3rd. Victorian Railways. Portable electric welding set and accessories. Secretary for Railways, Spencer Street, Melbourne.*

Edinburgh. — October 13th. Corporation. Electric lighting installation under the new housing scheme. (September 26th.)

Glasgow.—October 24th. Parish Council and District Board of Control. Electric lamps. Forms from the Inspector and Clerk, 266, George Street, Glasgow.

Madagascar.—March 1st, 1920. Directeur des Travaux Publics à Tananarive. Installation of generating station, with equipment, at Falls of Volobe, near Tamatave; erection of overhead transmission and distribution lines, and establishment of service in the city. Ministère des Colonies, Paris.

Manchester. — October 14th. Tramways Committee. Steel girder tramway rails. Specification, &c., from Mr. J. M'Elroy, General Manager, 55, Piccadilly, Manchester.

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development and Intelligence), London.

CLOSED.

Stepney.—B.C.:—

6,230 tons of screened peas and nuts at prices varying from 33s. 2d. to 36s. 7d. per ton.—E. Foster & Co.

100 tons of mixed washed singles, 40s. 8d. per ton.—Cory Bros. & Co., Ltd.

Apparatus for improving the vacuum of turbine condensers, £573.—Hick, Hargreaves & Co., Ltd.

FORTHCOMING EVENTS.

Electro-Harmonic Society.—Friday, October 10th. At the Holborn Restaurant (Venetian Chamber). At 8 p.m. First smoking concert.

Junior Institution of Engineers.—Friday, October 10th. At the Shipping, Engineering and Machinery Exhibition, Olympia, W. At 7.30 p.m. Lecture on "Some Hydraulic Exhibits," by Dr. H. S. Hele-Shaw.

Friday, October 17th. At 99, Victoria Street, S.W. At 7.30 p.m. Paper on "The Manufacture of Collapsible Tubes," by Mr. E. R. Sharpe.

Birmingham and District Electric Club.—Saturday, October 11th. At the Grand Hotel, Birmingham. At 7 p.m. Paper on "Notes on Private House Electric Lighting Installations," by Mr. C. M. Walter and Mr. R. G. Marsh.

North of England Institute of Mining and Mechanical Engineers.—Saturday, October 11th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2.30 p.m. Ordinary meeting.

International Shipping, Engineering and Machinery Exhibition.—Open until October 17th. At Olympia, West Kensington, W.

NOTES.

The Electrical Eye.—Speaking at the British Association, Bournemouth, Sir Oliver Lodge gave a sketch of a new theory of vision. We see very much better than we ought to, if we judge only from the degree of light, and there seems to be an electrical energy in the eye itself which "shoots off electrons." In short, the eye is an electrical sense organ of intense sensitiveness and energy, which energy is liberated by the light falling upon it and allowing it to make use of its atomic energy.

U.S. Coal Production.—The official figures of the American Geological Survey relating to coal production show that for the year 1918 there was a total output of 579,386,000 net tons of bituminous coal, a figure less by 1·1 per cent. than the estimate published eight months ago. The total production of coal, anthracite, bituminous, and lignite, in 1918, was 678,212,000 net tons. Pennsylvania ranked first in output, with West Virginia second and Illinois a close third. The number of men employed in the production of bituminous coal in 1918 was 615,300, compared with 603,143 in 1917. The average number of days worked, the highest recorded, was 294, compared with 243 in 1917. The total value of the production of the bituminous coal mined in 1918 was nearly $1,500,000,000, and of both bituminous and anthracite coal, $1,828,423,000. The average value per ton realised for bituminous coal was $2·58, compared with $2·56, the estimated weighted average of the established Government prices in effect throughout the year.—*Electrical Review*, Chicago.

Australian Electric Steel. — The Australian Electric Steel Co. was formed about two-and-a-half years ago, with headquarters at Sydney. The plant at present in use is of comparatively small output, namely, some 2,000 tons per annum, but the firm is already engaged in duplicating it, and will shortly be erecting a similar plant, supplied with power from the Government Electric Power Station of Western Australia, on a convenient site close to Perth. In order to carry out these developments it has been necessary to increase the capital of the company from £40,000 to £160,000. Of the various raw materials that are used there is practically only one that it is absolutely necessary to import. On the other hand, with the exception of carbon steel castings, all the other products of the industry, such as special alloy steels, are admitted duty free. Some idea of the scope covered by the company in its manufacture of high-grade steel by the electric process may be gathered from the following. Its manufactures comprise a full range of carbon-steel castings, according to the purpose for which the material is required. Included in the various low-carbon articles which have been turned out are:—Steel furnace jackets for copper furnaces, large annealing pots for wire annealing, and cast steel locomotive frames. There are also being made cast steel hydraulic cylinders, Huntingdon mill rings, and other wearing parts for grinders and crushers, varying from medium to high-carbon steels. In addition, ingots for locomotive tires and axles have been manufactured for several State railways, as well as steel for well-boring tools and bits, and for crankshaft forgings for gas engines, compressors, &c. In alloy steels, the company is making chrome-steel parts for grinders and crushers; also the whole range of manganese steel parts. Included in the operations are chrome-vanadium steel for piston rods, nickel steel for pump spindles, and other alloy steels. Ferro-silicon has also been made in fairly large quantities, as well as ferro-chrome; and it is anticipated that ferro-manganese will be manufactured shortly. It is also claimed that there will be no difficulty in making steels to the specifications required for aeroplane construction. The development of this important industry will depend entirely upon the attitude of the Government towards it through the tariff.—*Iron and Coal Trades Review.*

A Wire-Testing Extensometer.—An extensometer for testing wire and other thin sections has been developed at the research laboratory of the Westinghouse E. and M. Co. It consists essentially of a metal block to which two flexible side pieces are attached, the free ends of these carrying rollers; the wire to be tested is clamped at the block and passes between the rollers. Extension of the wire between the blocks and rollers due to loading the wire results in rotation of the rollers, which are held in contact with the wire by the flexibility of the side pieces. Light from a small straight-filament galvanometer lamp passes through a collimating lens to a mirror in the axis of one roller. From there it is reflected to a similarly placed mirror on the other roller, and reflected from there to a white scale divided into millimetres. An extension of approximately ·0001 in. causes a movement of the spot of light by a distance of 1 mm. on the scale; the position of the spot of light could be read to ½ mm. According to the *Journal* of the Franklin Institute, the instrument has been in constant use over a period of several months with very satisfactory results. Specimens have been tested having sectional areas ranging from one-tenth to twenty millionths of a square inch, with satisfactory results. A patent application has been made covering this instrument.

An Electric Furnace Regulator.—*La Nature* describes an automatic regulator for low-temperature electric furnaces, invented by M. Lequex, whereby the temperature is accurately controlled. The device consists of a glass tube inclined at 30°, and connected at its upper end with a vessel containing a fluid which undergoes considerable dilatation under the action of heat. The lower end of the tube connects with a vertical cylinder containing mercury in which is an adjustable piston. In the sloping tube, where the mercury enters up to a certain height, are spaced platinum contacts connected with points on the coil of a rheostat. The device is placed in the furnace, and when the latter is cold the platinum points are short-circuited by the mercury. The furnace, therefore, receives the full current. With a rise in temperature the liquid in the upper vessel expands and forces down the mercury, thus putting into circuit a succession of the various sections of the rheostat connected to the platinum points and diminishing the current. The device is intended primarily for laboratory furnaces heated by electricity, but the same principle may be applied to other forms of apparatus so heated.—*English Mechanic.*

"Too Much of the Hun."—Addressing the annual meeting of John Brown & Co., Ltd., at Sheffield, on September 29th, Sir Charles Ellis said that the Coventry Ordnance Works were concerned with armaments pure and simple, and they could not possibly be continued under existing conditions. The company had there, however, a very large plant of modern and valuable machinery, and the directors came to the conclusion that the best purpose, apart from armaments, to which this machinery could be adapted was in connection with large electrical installations. They had accordingly made arrangements, which they considered perfectly satisfactory, to join forces with other large electrical machinery producers, and the English Electric Co., Ltd., had been formed, which would be capable of dealing with every class of electrical installation, from the biggest to the smallest. It was, he thought, a very important and a very valuable decision. The English Electric Co. was a purely British concern. There had been rather too much Hun about some of the electric companies and they were determined to keep themselves a British concern

Fuel Economy in Power Production. — At a general meeting of the South Wales Institute of Engineers, held at Swansea, on September 23rd, Mr. H. T. Wales in the chair, discussion was continued on the paper of Mr. W. T. Lane on "Fuel Economy in Power Production." Prof. Frederic Bacon, referring to the author's citing of a 5,000-K.V.A. turbine with a guaranteed consumption of 10.2 lb. of steam per KW.-hour, or 7.6 lb. per H.P.-hour, claimed that South Wales thus possessed the most economical steam turbine yet produced, because the figures were evidently based upon a plant mentioned in his last paper by the late Mr. George Hann as being on order by the Powell Duffryn Co. This record the professor compared with a Parsons turbine set of 12,500 K.V.A. capacity at Rotherham, the guaranteed consumption of which was 11.5 lb. of steam per KW.-hour, and with a 30,000 K.V.A. turbo-generator at the same station with a guaranteed consumption of 11.1 lb. of steam per KW. hour. Thus Mr. Lane could point in South Wales to a turbine of only one-sixth the size of this mammoth having a guaranteed consumption of 1 lb. of steam less per KW.-hour. No doubt, added the speaker, there was an explanation of this. It might be that the steam pressure was not less than 350 lb. to the sq. in., with temperatures running up to 750 deg. F., which would approach the limit of what could be attained with such steel castings and steam pipes as were now available.

The Railway Strike.—On the 1st inst. a meeting was convened by the Transport Workers' Federation to consider what help should be given to the N.U.R. in the strike. The tramway and omnibus workers postponed action till after the conference. Over 30 unions are affiliated to the Federation, and in addition the following organisations outside were invited: Engineers, shipbuilders, printing trades, electricians, railway clerks, postal federation, National Federation of General Workers.

Minor sabotage was reported as under: Signal wires were cut at Swanage; keys were removed from rails at Snate Junction (G.E.R.); Hoe Street (G.E.R.) strikers threatened a working gang; and at East Malden (N.E.R.) a platelayer's lorry was put on the lines.

The Central London Tube railway reopened at noon on the 1st inst. between Shepherd's Bush and Liverpool Street. From Waterloo (L.S.W.R.) more trains were put on the Hampton Court-Surbiton-Wimbledon electric line, and on the L.B.S.C.R. the Victoria-Streatham Hill electric service was maintained. The Piccadilly Tube restored on Thursday, last week, a service between Hammersmith and Finsbury Park; trains were also running on the Inner Circle between Liverpool Street and Edgware Road. The District Railway extended its service at noon to Aldgate East, and on Friday morning to Ealing Broadway. The Waterloo (L. & S.W.R.) Barnes, Twickenham, Hounslow, Brentford electric service was commenced on Thursday morning The resumed electric services gave welcome assistance to the public and considerable relief to the traffic congestion generally. On Thursday and Friday the Government took a firm stand on its condition that the railwaymen must return to work before the wages negotiations were resumed. Mr. J. H. Thomas still refused to accept this, and announced that the negotiations had broken down. The Transport Workers' Federation deferred action till Tuesday, but the Croydon omnibus and tramway workers passed a resolution in favour of a strike within 24 hours.

Mr. J. Meakins, presiding at a mass meeting of the Electrical Trades Union, National Union of Enginemen, Firemen and Electrical Workers, the Workers' Union, and the National Union of General Workers on Thursday last week said the Joint Negotiating Committee of the four Unions had met to discuss the situation, and the following resolution was passed: "That this committee have had brought to their notice that members of the Electrical Power Engineers' Association and others are 'blacklegging' members of the N.U.R. and the E.T.U. now out in the dispute on the railways, and we ask the executives of the four Unions to grant permission to their London District Committees to withdraw their members from any power station in the London district who are supplying officials, men, or current to any railway undertaking."

The Bakerloo Tube began running on Saturday morning between the Elephant and Castle and Paddington, also the Hampstead Tube branch between Highgate and Leicester Square was reopened. Failure of power caused a stoppage of the Underground railways between 8.45 and 9.15 a.m. on Saturday. The District, Hampstead (and Highgate), Piccadilly, and Bakerloo lines were involved. On Friday the power station at Neasden was reported to have been in commission all along by the aid of volunteers, and from the L. & N.W. station at Stonebridge Park power was available for all electrified sections of the L. & N.W. and North London railways. Further acts of sabotage were reported, including several attempts to derail trains in different parts of the country; an engine was damaged at Glasgow. Attacks on volunteer workers, including the throwing of corrosive liquid when one man received bad injury to his eyes, and supposed attempts to shoot employés and officials, were also reported.

The strike was settled on Sunday afternoon, the ninth day of the stoppage. The terms are as under: Work to be resumed forthwith; negotiations on new standard rates to be completed before December 31st; present rates of wages to remain until September 30th, 1920, instead of March 31st, as previously pledged; and minimum rate for adults to be 51s. per week until the cost of living has fallen another 5 per cent. (to 110 per cent. over pre-war level). Briefly, the settlement gives the lowest-paid men an immediate increase of 2s. per week; it assures every man his present pay for nine months longer than the agreement come to last March, and increases by six months the Government's pledge, given last week, that wages would not be affected before April.

Our correspondents report that industrial concerns in Leeds which depend on steam power feared stoppage because of shortage of coal consequent on the railway strike, but the situation was greatly eased by the use of the canals. Two big firms, however, had to close down. All engineering and textile factories using Corporation electrical power, on the other hand, were assured that there was little reason for uneasiness, as the electrical department had secured good stocks of coal.

It was found necessary, owing to the restricted coal supplies and the difficulty of transport that arose, to arrange for curtailed services on the Dublin and Belfast (electric) tramway routes, and in the case of Dublin for the withdrawal of all services after 8.30 p.m. The electric lighting supplies, public and private, were economised to some extent, but not compulsorily. Power for industrial purposes was well maintained. At Rathmines Urban Council it was reported that three weeks' supply of coal was held at the electricity works.

Radio-telegraphy by Invisible Infra-red Radiation.—Messrs. J. H. Stevens and A. Larigaldie have perfected a detector apparatus, particulars of which have recently been communicated to the Paris Academy of Sciences. With their device they have been able to obtain records of infra-red radiations over distances of more than 20 km., the best results being obtained with a thermocouple. In the tests as carried out the source of emission was an arc or electric lamp projector, the luminous flux of which was absorbed by a filter screen, a black glass coated with manganese dioxide or gelatine. These screens absorb 50 per cent. of the total energy, but do not allow any rays which may affect the eye to pass. The receiver is a parabolic mirror arranged to trap the maximum of radiant energy; the thermopile being placed at the focus of this mirror. A metal plate 1/100 mm. thick is autogenously welded to the point of a crystal of high thermo-electric power. The thickness of the plate and the diameter of the point of contact were kept as low as possible so as to form a whole of very low thermal capacity. The best results were obtained with a platinum plate and a crystal of tellurium tempered and welded in the direction of crystallisation. The junction is enclosed in a glass bulb having a special window. The thermocouple is mounted at the terminals of a lamp amplifier, the current being broken by a ticker of musical frequency. A potentiometer is connected up in the circuit in order to obviate all eddy currents due to the surrounding conditions which might cause a difference of constant temperature between the two junctions. The diminution in the radiant energy captured at the receiver is generally proportional to the distance covered from the transmitter, but regard must be had to the absorptive power of the atmosphere, which is sometimes low and sometimes considerable according to the proportions of water-vapour, fog, dust, &c. Where the thermopile is not used in telegraphy but in pyrometry, in tele-mechanics, or for revealing the presence of bodies whose temperature differs from that of the surroundings (*e.g.*, of icebergs at sea), its current is passed into a fairly sensitive galvanometer to give a deflection of 3 to 4 mm. per micro-ampere (2 to 3 ohm coil). For ships the authors have designed a special double pivot galvanometer of the same sensitivity as the previous one, which is capable of working in any position and is unaffected by pitching or rolling. In September, 1918, signals were exchanged between two stations 14 km. apart. The transmitting station was provided with an arc projector of 1.50 m. In May of this year signalling experiments were made between two stations 7,500 metres apart. At the transmitting station there was a 0.40 m. mirror and an 800-watt nitrogen-filled electric lamp; while at the receiving station a gilt mirror of 0.24 m. was used.—*Technical Review.*

Japanese Electric Railways.—In 1895 the first practical electric railway was put into service. This, the Kyoto railway, was a success from the start, and there are now 90 electric railway companies in Japan, including 16 which have lines under construction. Tokyo, and some of the largest cities, possess municipally-owned electric railways. Electrification of the steam lines has made very slow progress, but there is abundance of undeveloped water-power in the country. Passenger traffic between Tokyo and Yokohama is mainly hauled by electric power, and the long tunnel at Usui has been completely electrified, passenger as well as freight trains being hauled by powerful electric locomotives. As a business proposition the electric railway in Japan is not very profitable; but there is still a field for new interurban and suburban railways. A great variety of gauge is in use, the 3 ft. 6 in. predominating. As a general policy, the single-trolley system is used on suburban railways, and the double-trolley contact system is standard for street tramways. High-speed electric railway operation between Tokyo and Osaka, a distance of 356 miles by the present steam route, is contemplated, and powers are being sought from the Government to enable the project to be carried through.

French World-wide Wireless Scheme.—In a recent issue of the *Génie Civil* M. Boutillon, head of the Government wireless department, outlined a scheme now under consideration in France for embracing the whole globe with wireless stations erected wholly on French territory. As the result of a mission to America in 1917, at the instance of the Administration of Posts and Telegraph, to study the great wireless systems on the New World, the author had come to the conclusion that to sufficiently assure the continuity of communication at great distances it was needful to adopt powers much higher than those now usual. All the great stations in existence (with ranges from 5,000 to 8,000 km.), with the exception of Nauen, employ powers between 200 and 400 KW., and possess antennæ ranging in height between 150 and 200 metres. The energy radiated from them is over abundant in the periods most favourable for transmission, but is insufficient when, as often in summer, to unfavourable conditions of transmission are added strong atmospheric disturbances. Communication then may remain impossible often for many hours together. To overcome this inconvenience the author holds it needful to raise the power to at least 1,500 KW. and adopt antennæ of at least 500 metres in height. As to the system of emission the author, although he has specially devoted himself to perfect the musical spark oscillation method, recognises that for communication to a great distance, the general practice decidedly and almost without exception favours the use of the continuous waves. With stations of the power proposed and having ranges up to 7,000 km. it would be possible to communicate for six hours each day in summer and 12 hours in winter, while the use of multiplying adjuncts would allow of the increase of transmission from the usual 140 words per minute to 200 words, and the issue and reception of more telegrams with the same antennæ. But in unfavourable conditions it would always be possible to transmit at a speed of 20 words per minute as the periods of interruption would be shorter and fewer on account of the great power employed. As regards the world-embracing network, the author proposes a continuous line of stations of about 6,000 km. range, which, starting on the west, will comprise the stations at Tahiti, Nouvelle, Calldonie, Indochina, Djibuti, and France, where splitting into two arms it will terminate at the Senegal and Martinique stations respectively. The centre of the network is naturally placed in France, and comprises a station of medium power able to communicate with North Africa and three stations of great power to communicate respectively with (1) the United States; (2) Martinique and Brazil; (3) West Africa, and with Djibuti. In West Africa, at Djibuti, and in Indo-China there will be double stations (one of great power to communicate at great distances, and one of medium power for local uses). In detail the network will comprise (1) a quadruple station in France (three stations of great power and one of medium power); (2) Three double stations; West Africa, Djibuti, and Indo-China (one large station and one medium); (3) three stations of great power; Martinique, Nouvelle Caledonie, and Tahiti; (4) six stations of medium power: Morocco, Algeria, Tunisia, Congo, Madagascar, and French India. As to the organisation of the multiple stations the author proposes to place transmission centres at considerable distances one from the other. For instance, in France the four transmission centres will be situated at Arles, Nimes, Bordeaux, and Basse Loire. Reception posts may be placed near those of transmission, and at such a distance as to permit the service in duplex or (and this solution the author seems to prefer) may be united in a single centre of reception near Paris, in which case they will command by wire with the four transmission posts.

Reorganising the A.I.E.E.—A most thorough-going revision of every line of association activity has been proposed by the Development Committee of the A.I.E.E. Briefly, these changes involve an enlargement and popularisation of the *Proceedings*. More officers from a wider area with fewer meetings. Decentralisation—the fostering of local sections; the holding of meetings elsewhere than in New York; the formation of a New York section. The encouragement of younger members entering into activities. The wider participation of the engineer in public affairs. The federation with other engineering bodies, both locally and nationally. The broader education of engineers to be secured by a six-year college course.

These proposals are almost revolutionary in the breadth of reorganisation they propose, but so nicely are they suited to the spirit of the association, that in regard to most of them very little has been heard except in their commendation. It is generally recognised that the engineer should take a more prominent part in public affairs and the federation of local engineering branches to present a stronger unit of influence is merely a reflection of a principle already recognised. The major exception to the general acceptance of the committee's report seems to be the change in the form of the Institute *Proceedings*. While it seems to be generally felt that there should be a broader policy as regards the matters of interest presented in addition to the technical papers, there has developed a widespread protest against the transformation of the *Proceedings* into merely another technical magazine. The attempt to extend the advertising columns is felt to be an unwarranted intrusion of the association into the field of the technical Press with which it has no aspiration to compete. It is of course recognised that under no consideration should the technical standards of the present be lowered. Under some protest, but under the urge of a broader service, the technical Press has gradually come to occupy a semi-popular field in which the severely scientific subject of special application plays only a limited part. Nevertheless, these treatises have their legitimate and important place—when a man wishes to find up-to-date technical data on a given particular subject, they should be available. Most legitimately, the refuge of such papers has been their publication by engineering societies.

X-Ray Chemical Analysis.—The method of X-ray crystal analysis developed in the research laboratory of the General Electric Co. just before the war is being further developed, as a method of chemical analysis, which promises to have a wide field of application in that it gives the form of chemical combination of each of the elements present, says Mr. A. W. Hull in the *Journal* of the Franklin Institute. The method consists in reducing the substance to be examined to powder form, placing it in a small glass tube, sending a beam of monochromatic X-rays through it, and photographing the diffraction pattern produced. The only apparatus required is a source of voltage, an X-ray tube, and a photographic plate or film. The amount of material necessary for a determination is one cubic millimetre. The method is applicable to all chemical elements and compounds in so far as they are crystalline in form. The rays from the X-ray tube pass first through a filter, which absorbs all but a single wave length, then through two slits, which confine them to a narrow beam (about 1 mm. wide); then through the powdered material, which scatters or "reflects" a very small fraction of them; and thence to the centre of the photographic film. An exposure of from one to twenty hours is required, according to the amount of information desired. When the film is developed it shows, in addition to the over-exposed line in the centre, where the direct beam strikes, a series of other lines on each side of the centre. These lines are caused by the "reflections" of the X-rays from the tiny crystals in the powder. Their distance from the centre of the film depends on the distance between the planes of atoms in the crystal, and there is one line for every important set of planes in the crystal. It is evident, therefore, that substances with different crystalline structures will give entirely different patterns of lines. Substances of similar chemical nature and therefore similar crystal structure give similar patterns, but the magnification or spread of the pattern is different for each one, being inversely proportional to the cube root of the molecular volume. Since no two similar substances have *exactly* the same molecular volume it is easy to distinguish them, as the difference is cumulative for lines far from the centre. A further distinguishing mark is the relative intensity of the different lines which differs greatly even in the most closely related compounds, depending on the relative shapes and sizes of the atoms in the compound.

A knowledge of the theory of the production of these lines, and their relation to the crystalline structure of the substance, is not essential to their use for chemical analysis. All that one needs to use in a chemical analysis is the fact that every crystalline substance gives a pattern; that the same substance always gives the same pattern; that no two different substances give the same pattern; and that in a mixture of substances each produces its pattern independently of the others, so that the photograph obtained with a mixture is the super-imposed sum of the photographs that would be obtained by exposing each of the components separately for the same length of time. This law applies quantitatively to the intensities of the lines, as well as to their positions, so that the method is capable of development as a quantitative analysis. Several actual analyses have already been made, and it has been found very easy to recognise at a glance each component in a three component mixture and in the case of the simpler salts many more than this could certainly be identified. Accurate quantitative tests have not yet been made, but it is anticipated that an accuracy of 1 per cent. will be easily obtainable, for components present to the extent of 1 per cent. or more of the whole sample.

Rectifying H.T. Alternating Currents.—Under the present-day conditions it is possible to obtain A.C. voltages up to almost any value if necessary, but it is relatively difficult to produce H.T. unidirectional currents. Some interesting experiments with a point-plate H.T. rectifier are described in the *Electrical World* of September 13th last. Owing to the dissymmetry of spark-gap electrodes, an electric current can flow much more easily in one direction than in the other when the spark gap included in the circuit has a point on one side and a plate on the other. Consequently an alternating E.M.F. supplied to the circuit tends to produce a rectified unidirectional current. This rectifying tendency has not been available for any important service owing to the inefficiency of the spark gap under ordinary conditions in air. The article states, however, that in other gases, particularly in ammonia, and with the aid of an increased hydrostatic pressure, the rectification becomes stabilised as well as improved in efficiency. The commutator cannot be employed to rectify alternating currents above a certain limit of voltage because of its arc-over properties. It would be remarkable if the arc between dissymmetrical electrodes were to replace the commutator as a high-tension rectifying device.

Educational.—THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, South Kensington, has postponed its reopening for the autumn term till Tuesday, October 14th.

A Military Electric Station Burned Down.—Last week the electric power station at the Military Camp, Randalstown, County Antrim, was destroyed by an accidental fire. The fire picket promptly got to work when the fire was discovered, but all effort was unavailing, and the entire building and plant were burned down. The cause of the fire is unknown. The camp is in a loyal portion of the country, so that anti-British motives are not suspected.

Electro-Harmonic Society.—The first smoking concert of the season will be held at the Holborn Restaurant, in the Venetian Chamber, to-night (Friday) commencing at 8 p.m. The artistes will be as follows:—Mr. Leonard Lovesey, tenor; Mr. Lawrence Folker, baritone; Mr. George Gower, banjoist; Mr. T. C. Sterndale Bennett, original humorous songs at the piano; Mr. Fred Curtis, humorist; Mr. Rupert Hazell, humorous songs, stories, sketches, and phono-fiddle solos; and Mr. Bernard Flanders, A.R.A.M., pianoforte solo and accompanist.

Welding Rotor Bars.—Writing to the *Electrical World*, a correspondent states that he has found it possible to weld rotor bars successfully to the end rings of a squirrel-cage rotor with an ordinary brazing outfit. The secret of a good job is in keeping the rotor bars and insulation in water up to the point of welding, to prevent overheating and burning. The temperature required to burn off all grease and dirt, and thus make a good weld, is very high. However, when the rotor is held in water, as mentioned, this high temperature has been satisfactorily used on repair jobs, and a good electrical connection between the bars and end rings secured.

Appointments Vacant.—Boiler-house chemist (350 taels per month), second assistant mains engineer (350 taels per month), assistant draughtsman (350 taels per month) (tael = 3s. average, present rate 6s. 3d. is abnormal), for the Shanghai municipal electricity department; electrician for the Sheffield water works; assistant lecturer and demonstrator in electrical engineering (£300 to £350) for the Battersea Polytechnic; assistant in the electrical engineering department (£250) for the Sunderland Technical College; meter tester (70s.) for the Darwen Borough Electricity Works. See our advertisement pages to-day.

Institution and Lecture Notes.—Paisley Association of Electrical Engineers.—At the inaugural meeting of this Association, held in the Y.M.C.A. Rooms, Paisley, the following office-bearers and Committee were appointed:—Mr. W. Blair Smith, president; vice-presidents, Messrs. W. Robert Scott and W. B. Bruce; honorary secretary, Mr. E. D. Anderson, B.L., 96, High Street, Paisley; honorary treasurer, Mr. J. M. Barbour, Electricity Offices; Messrs. D. E. Craven, Alexander McCrorie, R. N. McMaughtan, Joseph Savage and B. Thomson. The object of the new Association is the promotion of interest in electrical matters in the district, by the reading and discussion of papers on electrical and allied subjects, and by visits to electrical and other engineering works. Membership is open to those interested in electricity, and intending members are requested to communicate with the Honorary Secretary, Mr. E. D. Anderson.

Junior Institution of Engineers.—The report of the Council for the past year shows a record increase—15 per cent.—in the membership, which now numbers 1,813. The formation of an Australian Section at Melbourne is recorded, and the list of papers read, and visits paid, to engineering works covers a wide range. The *Engineers' Register* has assisted 658 members, and 87 have obtained appointments by its means.

Institute of Marine Engineers.—On Tuesday last a paper on "The Development of the Internal-Combustion Engine" was read by Mr. Charles Baxter at the Shipping Exhibition.

Export Prohibitions.—The *London Gazette* for October 3rd contains particulars of certain alterations in the Schedule of Prohibited Exports. The following heading is deleted:—A. Telegraphs and telephones; wireless, and instruments for wireless; telegraphic and telephonic apparatus, including valves.

Tramway Employés' Wages Award.—The award, resulting from the inquiry which followed the application of the National Transport Workers' Federation for a 12s. per week wages increase for tramway and omnibus workers, was issued on Wednesday, as follows:—Employés of 18 and over, 4s.; under 18, 2s. The award is to apply only to those grades of employés with respect to which there are agreements between the companies and the London and Provincial Union of Licensed Vehicle Workers, and is to take effect from the beginning of the first pay period following October 1st.

Fatality.—As passengers were landing from the Transporter Bridge which links Lancashire and Cheshire at Runcorn on Saturday, the bridge suddenly receded one yard, and a man named David Henry Howard stepped over the end, fell between the car and the roadway, a distance of 20 ft., into the Manchester Ship Canal, and was drowned. At the inquest on the 8th inst. Mr. Wood, engineer to the Widnes Corporation, said he had found cobwebs on the collector pulley and the driver's cabin. He believed these were saturated with moisture from fog, and that a certain amount of electric current leaked along them to the car switch, causing a momentary movement of the car. Mr. Craik, for the Widnes Corporation, said the highest authorities would be consulted to solve the mystery. A verdict of "Accidental death" was returned.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station and Tramway Officials.—Manchester Corporation Electric Committee has appointed Mr. A. G. Amey, of Liverpool, steam engineer at Stuart Street Station, at a salary of £300 per annum inclusive of war bonus.

Mr. R. W. Grubb has been appointed borough electrical engineer under the Dewsbury Corporation, at £450 a year.

Inspectors A. Broadbank and W. Leach, of the Southend-on-Sea Corporation tramways, on completing 18 years' and 9 months' and 19 years' service respectively, have each been presented by the staff with a clock and a wallet of notes.

Mr. Makin, assistant engineer, has been appointed to succeed Mr. H. P. Stokes as electrical engineer and tramways manager to the Bexley U.D.C., at a salary of £550 a year, subject to review at the end of six months' service.

Weymouth T.C. has increased the salary of the electrical engineer to £586 per annum for the year to March, 1920, and from April 1st, 1920, plus £1 for every 10,000 units in excess of one million. The salary of Mr. G. Nicholson, assistant electrical engineer, has been increased to £300.

Mr. J. Wilkinson, tramway electrical engineer of Hull, has resigned his position and commenced business on his own account under the name of Joseph Wilkinson & Co., consulting electrical engineers, and is dealing with light railway and tramway work, along with electrical vehicles.

Mr. Herbert Bell, electrical engineer to Hull Corporation, has just returned from a two months' tour of the U.S.A., where he has been studying the latest electrical developments.

Our local correspondent informs us that Col. Alex. Sinclair, chairman of the Swansea Corporation Electricity Committee, is almost certain to be the new Mayor of Swansea.

General.—The marriage has taken place at Glasgow of Mr. J. A. Livingstone, electrical engineer, of Manchester, and Miss Agnes Stewart.

Dartford U.D.C. has appointed Mr. F. H. Edwards, of Hayle, as electrical engineer, at a salary of £500 a year, subject to his undertaking the duties of engineer and manager of the light railways, if required to do so, at the expiration of the agreement with the Bexley U.D.C.

Captain H. L. Bazalgette, A.M.I.C.E., A.M.I.E.E., London Electrical Engineers (T.F.), has been appointed acting major between February 27th and June 26th, it is officially announced.

Captain D. A. Williamson, Tyne Electrical Engineers, has been appointed adjutant of the regiment.

Warrant Electrician W. J. Archer has been posted to H.M.S *King George V.*; Warrant Electrician C. H. Booth to H.M.S. *Assistance*, and Warrant Electrician J. Collins to H.M.S. *Conqueror*.

Lieutenant J. A. M. F. Jardine, Glamorgan (Electric Lights) Fortress Engineers, has relinquished his commission owing to ill-health. Lieut. Jardine was commissioned in the corps in February, 1915.

At the present rate of progress in reduction the various electric light companies of Fortress Engineers in Great Britain—there are no Territorials of any kind in Ireland—will soon be near the pre-war establishment. Few units on home service did more substantial work than the electric light companies, the strain on which was constant and arduous, particularly at naval bases, on which at any time attacks by the enemy might have taken place either by cruisers or submarine flotillas.

Obituary.—Lieut. W. V. Wright.—The death is announced of Lieut. Walter Vivian Wright, electrical engineer, of Newcastle-on-Tyne.

We tender our sympathy to Sir Gerald Edward Chadwyck-Healey, of *The Engineer*, on the death of his father, Sir C. E. Chadwyck-Healey, Bart., who passed away on October 3rd.

Mr. G. Gilpin.—The death occurred on Saturday last, at Crumpsall, Manchester, of Mr. George Gilpin, who joined the Electric Telegraph Co. in 1852. He went to Bradford in 1863 as clerk in charge, and was transferred to the Post Office in 1870 when the telegraphs were taken over, becoming superintendent of telegraphs. He organised the system in Bradford under the new rule, and in 1882 was responsible for the work of organising telephone exchanges in the North-Eastern District. He was chief clerk at Bradford Post Office from 1885 to 1901.

Mr. B. A. Raworth.—We regret to record the death of Mr. Benjamin Alfred Raworth, joint editor of *Engineering*, and brother of the late Mr. J. S. Raworth, who passed away on September 30th, at Sutton, Surrey, in his 71st year. The deceased gentleman was a Whitworth Scholar and a member of the Institution of Mechanical Engineers and other societies. In 1871 he was in the service of Sir Joseph Whitworth, and in the year following he accepted an appointment with Messrs. Siemens Bros., Woolwich, as draughtsman and assistant engineer. Later he joined Mr. J. S. Raworth at Manchester in connection with cotton spinning machinery development. Subsequently he entered upon the staff of Mr. (later Sir) Lloyd Wise, where he worked in connection with patent specification and patent case matters. This branch of his activities brought him into touch with *Engineering*, and he, as a result, joined our contemporary's staff in 1882. Upon the death of Mr. Dredge in 1906, Mr. Raworth became joint editor of the paper.

NEW COMPANIES REGISTERED.

Farndon's Electric, Ltd. (159,066).—Private company. Registered September 24th. Capital, £10,000 in £1 shares (5,000 preference). To carry on the business of electricians, mechanical engineers and manufacturers, &c. The subscribers (each with one share) are: F. Farndon, 441, Romford Road, Forest Gate, electrical engineer; H. King, 105, Meanley Road, Manor Park, E.12, electrical engineer. The first directors are: F. Farndon (managing director); P. Farndon, 186, Balsall Heath Road, Birmingham; H. M. Watson, 76, Carnarvon Road, Stratford, E.; and H. King (all permanent). Qualification, £100. Registered office: 32, Romford Road, Stratford.

George Black & Sons, Ltd. (159,337).—Private company. Registered October 1st. Capital, £20,000 in £1 shares. Objects: To take over the business of boiler makers carried on at Tweedmouth, Berwick-upon-Tweed, as "George Black & Sons," and to carry on the business of boiler and tank makers, ship repairers, electric welders, and to enter into an agreement with Margaret Black, A. J. Dodds and J. Goodall. The subscribers (each with one share) are: W. T. Weir, 11, Holywell Avenue, Monkseaton, building contractor; J. W. Glahome, 25, Queen's Drive, Whitley Bay, engineer. The first directors are: J. W. Glahome (managing director), H. W. E. Biggins (Abbeytown, Cumberland), and W. T. Weir. Qualification, £500. Registered office: Margaretville, Main Street, Tweedmouth, Berwick-upon-Tweed.

Ballymote Electric Lighting and Town Improvement Co., Ltd. (4,794).—Private company. Registered in Dublin, September 26th. Capital, £3,000 in £1 shares. To carry on the business indicated by the title. The subscribers are: A. McCabe, Ballymote, insurance agent, 10 shares; W. J. Lipsett, Ballymote, merchant, 50 shares; A. Rogers, Ballymote, merchant, 50 shares; P. E. Durcan, National teacher, 50 shares; W. Kane, Ballymote, merchant, 25 shares. The first directors are: P. O'Hart, W. J. Lipsett, J. Hannon, P. E. Durcan, W. Kane, J. Cawley, J. Healy, A. Rogers, A. McCabe and F. McDonagh. Secretary: P. E. Durcan. Registered office: The Market House, Market Street, Ballymote.

Christian Bergh Electric Co., Ltd. (159,258).—Private company. Registered October 2nd. Capital, £5,000 in £50 shares. To carry on the business of electrical engineers, &c. The subscribers (each with one share) are: H. F. Perry, 8, Park Grove Road, Leytonstone, E.11, cashier; W. H. Butterfield, 17, New Road, Crouch End, N.8, manager. The subscribers are to appoint the first directors. Solicitors: Swepstone & Co., 9, St. Helen's Place, E.C.

W. Brunton & Co., Ltd. (159,199).—Private company. Registered September 29th. Capital, £10,000 in £1 shares. To take over the business of safety fuse, electric fuse and electric detonator manufacturers carried on by A. Renfree, H. Renfree and F. Pope at The Lodge, near Wrexham, Denbigh, as "W. Brunton & Co." The subscribers (each with one share) are: A. Renfree, The Heublas, Wrexham, fuse manufacturer; H. Renfree, St. John's, Wrexham, fuse manufacturer; F. Pope, 18, Gerald Street, Wrexham, fuse manufacturer. The first directors are not named. Qualification, 20 shares. Solicitors: Allington, Hughes & Bate, Wrexham.

Sidney Stone & Co., Ltd. (159,224).—Private company. Registered September 30th. Capital, £8,000 in £1 shares. To take over the business of engineers and contractors carried on at 146, Bishopsgate, E.C.2, by S. Stone, as "Sidney Stone & Co.," and to carry on the business of electrical engineers and contractors, suppliers of electricity for light, heat, motive power or otherwise, &c. The subscribers (each with one share) are: S. Stone, 151, Melfort Road, Thornton Heath, Surrey, engineer; N. S. Beatty, Busch House, Isleworth, Middlesex, engineer. The first directors are: S. Stone and N. S. Beatty. Registered office: 70, Victoria Street, S.W.

H. Clarke & Co. (Manchester), Ltd. (159,067).—Private company. Registered September 24th. Capital, £25,000 in £1 shares. To take over the business of a manufacturer of and dealer in insulating materials and screws and general engineers' sundriesmen carried on by H. Clarke as "H. Clarke & Co.," at Eastern Street, Old Trafford, Manchester. The subscribers (each with one share) are: H. Clarke, 247, Monton Road, Monton Green, Manchester, insulating material manufacturer; E. Royce, 22, Cooper Street, Manchester, C.A. The first directors are not named. Qualification, £500. Registered office: 22, Cooper Street, Manchester.

Crowther & Sloan, Ltd. (159,144).—Private company. Registered September 26th. Capital, £3,000 in £1 shares. To take over the business of electrical factors carried on by Crowther & Sloan at Greenock Road, Armley, Leeds, to carry on the business of electrical, mechanical and general engineers, &c., and to enter into an agreement with H. Crowther and J. D. Sloan. The subscribers (each with one share) are: H. Crowther, 199, Hall Lane, Armley, Leeds, electrical factor; J. D. Sloan, Monreith, Sylvan Avenue, Sale, Manchester, commercial traveller. The first directors are: H. Crowther and J. D. Sloan (both permanent, subject to holding 100 shares each). Solicitor: H. Broadbent, 15, King Street, Leeds.

Amalgamated Electrical Works, Ltd. (159,136).—Private company. Registered September 26th. Capital, £5,000 in £1 shares. To carry on the business of electrical and general engineers and contractors, manufacturers of and dealers in electrical, magnetic and galvanic apparatus, wires and cables, &c. The subscribers (each with one share) are: F. H. W. Mendoza, Ranelagh House, Westbourne Terrace Road, Hyde Park, W.2, clerk; Constance Parker, "Maiville," Hartland Road, Friern Barnet, N.11, secretary. The subscribers are to appoint the first directors. Qualification, 50 shares. Secretary: A. S. Richards. Registered office: 44, Leadenhall Street, E.C.

Bell Battery Co., Ltd. (159,253).—Private company. Registered October 3rd. Capital, £15,000 in 9,000 preference shares of £1 each and 60,000 ordinary shares of 2s. each. To carry on the business of wet and dry electric cells, electricians, manufacturers of and dealers in electric appliances and apparatus of all kinds, &c. The subscribers (each with one preference share) are: M. Edenborough, Lloyds, Royal Exchange, E.C., insurance broker; O. W. Seligman, 52, New Broad Street, E.C., solicitor. Directors: M. Edenborough, O. W. Seligman, and L. Cornelis. Qualification, £10. Registered office: 52, New Broad Street, E.C.

Thomson Bennett (Magnetos), Ltd. (159,248).—Private company. Registered October 1st. Capital, £100 in £1 shares. Objects: To carry on the business of manufacturers of electrical and other component parts, accessories and fittings used in the construction, starting, running, driving and regulation of stationary engines, &c. The subscribers (each with one share) are: P. F. Bennett, Ardencote, Luttrell Road, Four Oaks, manufacturer; C. L. Breedon, Llanbede, Billesley Lane, Moseley, Birmingham, engineer. The first directors are not named. Registered office: Well Street, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

United River Plate Telephone Co., Ltd. (23,654).—Return dated July 8th, 1919. Capital, £2,000,000 in £5 shares (324,000 ordinary, 40,000 preference and 36,000 unissued). All the ordinary and preference shares taken up. £1,740,000 paid, £80,000 considered as paid. Mortgages and charges, £300,000.

United Electric Tramways of Montevideo, Ltd. (80,456).—Return dated July 9th, 1919. Capital, £1,000,000 in £5 shares (100,000 preference). All shares taken up. £5 per share called up on 26,221 preference and 32,800 ordinary shares. £295,105 paid. £704,895 considered as paid on 73,779 preference and 67,200 ordinary. Mortgages and charges, £959,587.

Electrical Apparatus Co., Ltd. (London).—Mortgage on freehold property at St. Albans, dated July 30th, 1919, to secure all moneys due or to become due from company to L.J.C. and Midland Bank.

Walter's Electrical Manufacturing Co., Ltd. (94,300).—Return dated July 24th, 1919. Capital, £13,000 in £1 shares. 11,250 shares taken up, £1,250 paid, £10,000 considered as paid. Mortgages and charges, nil.

CITY NOTES.

Ward & Goldstone, Ltd.—With reference to our notice of this company's issue of shares, as, owing to the railway strike, it was impossible for the last number of the Review to reach many of our provincial readers until after the closing of the lists on October 4th, we are asked to state that the directors are willing favourably to consider any applications for preference shares that may be received during the next ten to fourteen days. The company has already gone to allotment, but a few preference shares have been retained by the directors for disposal to old customers if they make prompt application.

Bombay Electric Supply & Tramways Co., Ltd.—The *Financial Times* says that cabled advice has been received of the declaration of an interim dividend for the half-year to June 30th last on the ordinary shares at the rate of 14 per cent. per annum.

J. Stone & Co., Ltd.—For 1918, the balance to credit of profit and loss account, after allowing for depreciation, &c., is £90,189, plus £116,702 brought forward. It is proposed to pay a dividend of 10 per cent. per annum, and a bonus of 1s. per share on the ordinary shares, carrying forward £131,861.

Companies Struck off the Register.—The following have been struck off the Register and are dissolved:—

Alpha Electrical Co., Ltd.
East London Electrical Co., Ltd.
G.O. Accumulator, Ltd.
Perfection Light Co., Ltd.
South American Railless Traction Co., Ltd.

Kaministiquia Power Co.—Dividend of $2 per share, or at the rate of 8 per cent. per annum, on the common stock, for the quarter ended September 30th.

Cuba Submarine Telegraph Co., Ltd.—Interim dividend for the June half-year at 5 per cent. per annum, free of tax, on the ordinary shares.

Northampton Electric Light & Power Co., Ltd.—A meeting was called for Monday last to consider a proposal to increase the capital to £250,000 by the creation of 50,000 shares of £1 each.

Dundee, Broughty Ferry & District Tramways Co.—Profit for year ended July, 1919, £5,653. After paying debenture interest, preference dividend, and 5 per cent., less tax, on the ordinary shares, £1,000 is put to reserve, and £341 carried forward.

STOCKS AND SHARES.

Tuesday Evening.

By the end of the week, when this issue is out, the railway strike will be quietly passing into history, but the immediate effect is still felt to-day (Tuesday) upon the Stock Exchange markets. Violent rises took place in many of the active departments. The Stock Exchange, thankful that the struggle is composed, heaves a quiet sigh that finality may not yet have been reached. A recurrence of the same old trouble is regarded as within the bounds of possibility, although in many ways it is thought that the air has been cleared by the strike now over.

It was in the middle of last week that the Stock Exchange waxed a little apprehensive, and a rumour spread that the electricians had threatened to "come out." The prospect of having the light cut off seemed to get on men's nerves more than the risk of failing to reach office or home. The technical experts hastened to cheer fainting spirits by reference to the chance of there being no papers (daily papers, of course) if the electricians struck and the linotype machines could not be operated. But this particular rumour, which appeared to be generated by the accidental tramway stoppage, died a rapid death, and the depression produced in a few electrical manufacturing issues was soon wiped out. Before the week ended, a recovery in this department served to encourage electrical shares generally, and the exuberance of markets, after the strike had been settled, was felt amongst all the industrial sections.

Home Railway stocks have experienced sharp rallies. Underground income bonds, which had been down to 92½, revived to 94. Other members of the group regained previous loss, and the steam stocks added points to their prices.

Out of the hurly-burly of the strike emerges the clear fact that the railways need no longer be deemed indispensable at a time of national emergency. The road has come to the front as a means of communication to an extent that takes us back to the post-war days of Roman occupation in this island. Roads and petrol, lorries and rubber—these are the new text-books from which lessons about the strike are being conned, and the boom in oil shares has been resumed with an astonishing vigour that overshadows all other speculative interest for the time being. It is common talk that railway

freights will shortly be increased by 50 per cent., and if this happens, it will prove a new advertisement for the other means of transport.

Speculation in the Stock Exchange received a sharp check from the nervousness created by the railway strike, and investment securities are growing into renewed favour. In the electricity supply list, County ordinary has risen to 3½ and Westminsters to 5¼, although City preference are dull. General Electric ordinary recovered to 2 and the preference to 20s. The telegraph list is quiet; both classes of Globe shares are rather better. Pronounced activity in Marconi shares is the feature here. The ordinary have risen to 5 15-16 and Canadians spurted to 17s. 6d., leaving Americans a little behind at 32s. 9d. Marconi Marines are steady at 3 3-16, but are thought likely to have their turn before long. Siemens have risen to 27s. 6d. On the other hand, Henleys at 2½ are 1-16 down. Babcock & Wilcox, quoted ex rights, have been lowered to 3½.

British Electric Traction 5 per cent. debenture stock at 83½ is a point harder. Potteries ordinary gave way to 13s. 9d. Calcutta Tramways are again harder at 8¼. British Columbia debenture stock has advanced smartly. The weakness of most Mexican issues continues, but the latest news respecting the country may have a stimulating effect upon this section before long—a pious wish so often expressed as to make its fulfilment some day, if it be repeated often enough, a matter of certainty. The market for rubber shares is better on a rally in the price of the raw produce, while iron, coal and steel shares recovered on the settlement of the strike. A cheerful feeling pervades the markets as a whole, and, although there is not a great deal of business doing, it is hoped that the way has been opened to a national peace which shall prove strong and enduring.

SHARE LIST OF ELECTRICAL COMPANIES

	Dividend 1917.	Dividend 1918.	Price Oct. 7, 1919.	Rise or fall.	Yield p.c.
Home Electricity Companies					
Brompton Ordinary	10	8	8	—	£6 13 4
Charing Cross Ordinary	4	4	2⅞	—	7 5 6
do. do. do. 4½ Pref.	4½	4½	3	—	7 10 0
Chelsea	5	5	⅞	—	5 0 0
City of London	8	8	11½	—	6 19 2
do. do. 6 per cent. Pref.	6	6	9⅛	— ¼	6 11 9
County of London	7	7	9½	+ ⅛	7 7 5
do. do. 6 per cent. Pref.	6	6	9⅛	—	6 11 9
Kensington Ordinary	7	8	4½	—	6 6 4
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	5	6	8½	—	8 11 6
Metropolitan	4	5	8	—	8 6 8
do. 4½ per cent. Pref.	4½	4½	6⅝	—	7 1 2
St. James' and Pall Mall	9	10	6¾	—	8 8 4
South London	5	6	2⅛	—	7 8 6
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	6½	+ ½	7 16 9
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	96	—	6 5 0
do. Def.	14	28/6	22½	—	7 9 0
Chile Telephone	8	8	6⅞	—	5 18 6
Cuba Sub. Ord.	7	7	10½	—	*6 13 4
Eastern Extension	8	8	15½	—	*5 0 10
Eastern Tel. Ord.	8	8	159½	—	*5 0 4
Globe Tel. and T. Ord.	7	8	15⅞	+ ⅛	*5 4 0
do. do. Pref.	6	6	10½	+ ⅛	5 17 1
Great Northern Tel.	22	23	20	—	7 11 9
Indo-European	18	18	47½	—	6 16 10
Marconi	20	25	5 13/16	+ 1/16	4 4 9
Oriental Telephone Ord.	15	10	2⅛	—	4 11 9
United R. Plate Tel.	8	8	7¼	—	*5 1 7
West India and Panama	1/8	1/8	1 1/16	—	*4 15 8
Western Telegraph	8	8	16½	—	*4 18 6
Home Rails.					
Central London Ord. Assented	4	4	10½	—	8 12 1
Metropolitan	1	1½	25½	+1	4 18 0
do. District	Nil	Nil	2⅜	+ ⅛	Nil
Underground Electric Ordinary	Nil	Nil	8	—	Nil
do. do. "A"	Nil	Nil	8/8	—	Nil
do. do. Income	4	5	91	+1½	*5 6 5
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4½	—	6 13 4
Anglo-Arg. Trams. First Pref.	5½	Nil	3	—	—
do. do. 2nd Pref.	—	—	2½	—	—
do. do. 5 Deb.	5	5	64½	—	7 15 6
Brazil Tractions	—	—	58	—	—
Bombay Electric Pref.	6	6	12½	—	4 16 0
British Columbia Elec. Rly. Pfce.	5	5	56½	—	8 17 0
do. do. Preferred	Nil	2½	4⅝	—	5 7 6
do. do. Deferred	Nil	Nil	30½	—	Nil
do. do. Deb.	4½	4½	58	+3½	7 6 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	50	—	Nil
do. 6 per cent. Bonds	Nil	Nil	42½	—	Nil
Mexican Light Common	Nil	Nil	32½	—	Nil
do. Pref.	Nil	Nil	48½	—	Nil
do. 1st Bonds	Nil	Nil	52½	—8	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3½xd	— ½	*4 16 0
British Aluminium Ord.	10	10	1½	—	5 18 4
British Insulated Ord.	25	12½	2⅝	—	5 19 4
Callenders	25	25	8⅞	—	7 2 10
do. 6½ Pref.	5	6½	5⅜	—	6 6 10
Castner-Kellner	25	20	2½	—	8 0 0
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	—	1½	—	6 0 0
do. do. 5 per cent. Deb.	4	5	81½	—	6 2 9
Electric Construction	10	10	1¼	—	8 18 0
Gen. Elec. Pref.	6	6½	1	+ 1/16	6 10 0
do. Ord.	10	10	2	+ ⅛	*5 0 0
Henley	25	25	2½	— 1/16	5 11 1
do. 4½ Pref.	4½	4½	3⅝	—	6 4 2
India-Rubber	10	10	17	—	*5 17 8
Met.-Vickers Pref.	—	—	8 1/16	—	4 16 8
Siemens Ord.	—	10	18	+1 1/16	*7 5 4
Telegraph Con.	20	20	25	—	*4 17 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, October 7th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£80	..
a Ammonia, Muriate (large crystal)	"	£78	..
a Bisulphide of Carbon	"	..	..
a Borax	"	£39	..
a Copper Sulphate	"	£42	..
a Potash, Chlorate	per lb.	1/1	..
a " Perchlorate	"	1/3	..
a Shellac	per cwt.	£24 10	..
a Sulphate of Magnesia	per ton	£15	..
a Sulphur, Sublimed Flowers	"	£28	..
a " Lump	"	£25	..
a Soda, Chlorate	per lb.	8d.	..
a " Crystals	per ton	£70/-	..
c Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£88 to £222	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/1½	..
c " Tubes (solid drawn)	"	1/5 to 1/5½	..
c " Wire, basis	"	1/3	..
c Copper Tubes (solid drawn)	"	1/7½	..
g " Bars (best selected)	per ton	£146	..
g " Sheet	"	£146	..
g " Rod	"	£146	..
d " (Electrolytic) Bars	"	£120	..
d " " Sheets	"	£154	..
d " " Wire Rods	"	£126	..
d " " H.C. Wire	per lb.	1/4½	..
f Ebonite Rod	"	3/-	..
" Sheet	"	2/6	..
n German Silver Wire	"	2/5	..
h Gutta-percha, fine	"	10/- to 11/-	..
h India-rubber, Para fine	"	2/6	½d. inc.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£42	..
g Lead, English Pig	"	£37 15	£1 inc.
g Mercury	per bot.	£19 10	£1 10 to £5 .. dec.
a Mica (in original cases) small	per lb.	9d. to 4/6	..
a " " " medium	"	5/- to 10/-	..
a " " " large	"	12/6 to 25/- per lb.	..
g Phosphor Bronze, plain castings	"	1/5½ to 1/7½	..
g " " rolled bars & rods	"	2/- to 2/4	..
g " " rolled strip & sheet	"	2/1 to 2/6	..
d Silicium Bronze Wire	per lb.	1/9	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	£291 to £292	£7 dec.
n " Wire, Nos. 1 to 18	per lb.	4/3	..
White Anti-friction Metals	per ton	£60 to £292	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Fuel Economy.—The Board of Trade make the following announcement with regard to the effect of the termination of the strike on restrictions in the use of coal and coke, gas and electricity:—

The Lighting, Heating, and Power (Emergency) Order, 1919, prohibiting display lighting has been revoked.

In view of the danger of a severe shortage of coal in the winter owing to the diminution of stocks during the strike, it is necessary to maintain for a short time the restrictions imposed by the Coal and Fuel (Emergency) Order, 1919, limiting deliveries of coal to 1 cwt. The Controller of Coal Mines will, however, authorise the relaxation of the restriction in those districts in which, in his opinion, this may safely be done.

The Gas and Coal (Emergency) Order, 1919, which prescribes a maximum calorific value of 425 B.TH.U. gross, and provides for the diminution of pressure in case of necessity, will also remain in operation.

The embargo which Local Fuel Overseers were instructed to place on 25 per cent. of all industrial stocks in their districts has been removed.

Moving Transmission Poles.—When it was necessary recently to move five 65-ft. (20-m.) poles carrying three 66,000-volt conductors, three 2,300-volt conductors, and a telephone line a distance of about 40 ft. (12 m.), the following method, described in the *Electrical World*, was successfully used:—When ready to transfer the poles to their new locations across an alfalfa field, each one was guyed both ways at right angles to the line. By the use of a Simplex polejack the pole was pulled out of the ground and attached to the rear end of a two-ton truck. The truck was then backed across the 40-ft. space between the old and the new locations, and the pole dropped into place. By this method it was possible to move the five poles without untying the lines. It would also have been easily accomplished without disconnecting the 66,000-volt circuit, but this was done as a matter of precaution.

THE SHIPPING, ENGINEERING, AND MACHINERY EXHIBITION.

(*Continued from page 424.*)

Metal Industries, Ltd., Sunbury-on-Thames, was formed to take over and develop commercially the Cowper-Coles Manufacturing Co., and Mr. Cowper-Cole's patent processes and inventions. A dry-vapour galvanising or sherardising plant is shown in operation; also a number of samples of work done by electro-deposition, such as copper tubes, cylinders, zinc boxes, and dry battery cells. This new process is claimed to be an improvement on sherardising; it has been found to be the best and the most economical for rendering iron and steel surfaces rustless. It consists of placing the article to be rendered rustless in a closed iron receptacle packed with zinc dust, a by-product of the zinc smelting furnaces. The drum and its contents, when heated to a temperature of about 700 deg. F. for a few hours, on removal are found to be coated with a white metallic coating of zinc, which is not a mere surface coating, but is amalgamated with or has penetrated the outer surface of the steel. One of the defects of the old sherardising process was the depreciation or alteration in the composition of the zinc dust, which oxidised and became inefficient. The new process claims to overcome this difficulty entirely, ensuring the zinc dust being kept in its best working composition so that an even quality of work is produced, and the new process also has the additional advantage that the time of sherardising is reduced to about one-half.

Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, London, W.8, and Siemens Bros. Dynamo Works, Ltd. These allied companies are exhibiting a ship's standard wireless telegraph station equipment, type H, including all the necessary apparatus for the transmission and reception of wireless messages, as well as an emergency set for transmission when the main electrical power on the ship is not available. The whole is installed at the exhibition exactly as would be the case on board ship. The exhibit illustrates the compactness of the apparatus and the absence of noise in the spark gap. The motor generator consists of a 0.75 h.p. d.c. motor driving a 0.5-kw. a.c. generator at 220 volts and 550 frequency. The pitch of the note transmitted is varied by adjusting the speed of the machine through the medium of a sliding resistance in the shunt circuit. The a.c. from the generator is stepped up from 220 to 8,000 volts for the transmitter by an iron-core transformer. The excitation circuit consists of Leyden jars, an 8-gap quenched-spark gap, and a variable self-induction, the latter being formed of a flat spiral of copper strip which carries plug sockets for various wave lengths. The wave range of the excitation circuit is from 300 to 600 metres, and is usually fitted with 3 fixed waves, viz., 300, 450 and 600 metres.

An aural receiver with contact detector is employed, which gives a wide range of coupling, and has a wave range of from 300 to 2,000 metres. The emergency transmitter consists of a battery and induction coil, and is put in circuit with the aerial by connecting two plugs on the transmitter. Operation is then carried on by means of a separate Morse key in an exactly similar manner as in the case of the main transmitter. The battery is composed of 17 accumulators having a pressure of 32 volts, and is so arranged that it may be charged from the ship's mains by a switch, which also inserts a charging resistance, fitted on the switchboard of the main transmitter. The batteries have a capacity of 60 amp.-hours, sufficient for continuous transmission for three hours. The induction coil is a specially wound 32-volt coil fitted with a hammer break. It is completely enclosed in a polished wooden box, and connection is made through two plugs.

A selection of cables are also shown for electric lighting and power suitable for installation on board ship, including samples of fibre and rubber-insulated cables, lead-covered cables (with and without armouring), and heavily armoured submarine or river type 3-core cable with pilot wires. Also samples of ring main as used for the main power supply on large war vessels, and "cab tire" sheathed cable cargo flexibles.

Loud-speaking telephones in watertight gunmetal cases for transmission between the bridge, engine room and various positions on deck, and an electric helm indicator for indicating on the dial the angle of the rudder or helm of a ship are exhibited. This indicator may be placed on the navigating bridge or other parts of the vessel; it is independent of the ordinary electric installation on the ship, the energy being obtained from a separate galvanic cell.

The electrically-operated engine revolution indicator is designed to be placed on the bridge or in the chart room; it indicates every revolution made by the engine, and shows the direction of rotation. The torsion meter (Hopkinson-Thring patent) is applied for measuring the power transmitted by propeller shafts, and utilises for this purpose the twist which occurs in the shaft when transmitting power. The meter is fixed to and rotates with the propeller shaft, the twist being indicated by a beam of light reflected from the mirrors on to a scale. The torsion meter has been in extensive use in the Navy and mercantile marine for the last ten years, and has given complete satisfaction. The navigation light indicator is an apparatus which shows at a glance whether the navigation lights are all burning. These indications are shown on a screen upon which is outlined a plan of the ship's deck, and on this screen there appear illuminating disks, each disk corresponding with a navigation light. Should any navigation light or lights fail on the ship, the corresponding illuminated disk or disks on the screen vanish, and a bell rings to call attention. An electrically-operated watertight depth indicator is used for indicating the depth of water in any tanks or holds of the ship. A transmitting device is fitted within each tank or hold, and the indicating apparatus may be mounted in the chart room or elsewhere. A selector switch is provided, which is placed near the indicator, and thus there may be ascertained the depth of water in any tank or hold. If the indicating instrument is left permanently in communication with any one of the holds or tanks, as may be done by leaving the switch handle in the corresponding position on the selector switch, a continuous reading of the rise or fall of water in the tank or hold in question may be obtained.

This firm is also showing a "Siemens 24" Suez Canal pattern searchlight projector mounted on a pedestal. The projector is provided with a split mirror and an 80-amp. lamp, and is fitted with both automatic and hand-feed control switch and fuses. The switch pillars and panels are of the company's standard type and of substantial design; they are specially suitable for marine work. The fan shown is typical of those used on board ship for ventilating saloons and cabins. The size shown is 12.5 in., and the motor is of the company's standard protected and shunt-wound type. A selection of standard motors, both totally enclosed and ventilated types, are included in the exhibit; they are all suitable for use on board ship. A typical example of small switchboards, suitable for ship work, is on view, and an emergency petrol generating set is of a type which is now largely installed on board ship. The Siemens "F.C." protected type generator has an output of 2.5 kw. at a speed of 1,180 r.p.m., and is coupled direct to the engine.

In addition to all the above, the exhibit includes an assortment of fittings, appliances, &c., used on board ship, such as fuses, circuit breakers, electric light fittings, cabin fans, electric lamps and cooking utensils. The company is also showing its latest type of dry and "Inert" galvanic cells. These cells are now appearing under a new label.

Submersible Motors, Ltd., Johnson Street, Southall, Middlesex. This firm has a very comprehensive exhibit of various specialities which present some novel and interesting features. The submersible electric motor, designed to run entirely under water, is in itself quite unique, as it is not a watertight motor, but is actually kept full of water all the time it is at work, this water being circulated through it and utilised to cool the windings and bearings. In combination

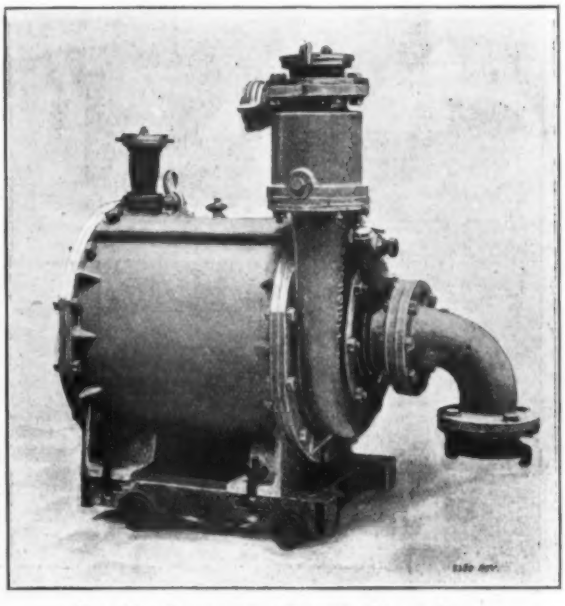


Fig. 12.—Submersible Electric Motor Pump.

with a centrifugal pump it forms an extremely compact piece of apparatus, figs. 12 and 13. Up to the present it has principally been used for marine salvage work and in emergency pumping operations. Many hundreds of these motor-pumps were supplied to the Admiralty during the war, and also to the French, American, and Japanese Navies.

Examples are shown of motors coupled to 6-, 4-, and 2-in. single-stage centrifugal pumps, also to a two-stage pump for a lift of 175 ft., and to a six-stage pump for a 500-ft. lift.

These latter have been specially designed for mining work. A 6-in. motor-pump is shown opened up so that the details can be seen. A feature in the manufacture of these motors is the coating of the surfaces of the rotors and stators with a zinc alloy, which is deposited electrically and forms a very effective rust preventative. The winding of the stators is an excellent piece of work; no insulating material is used in the slots in the stator core other than the insulation on the conductors themselves. The coils comprising each phase are

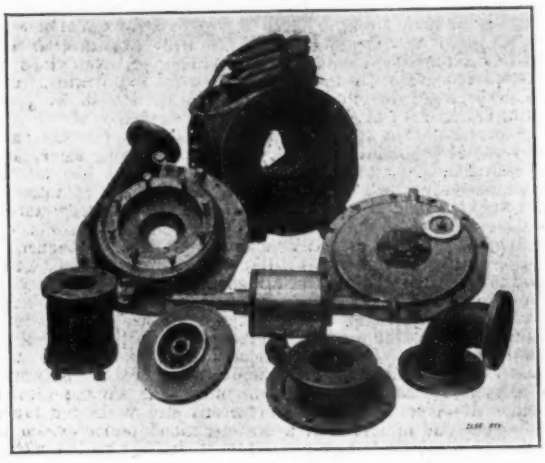


Fig. 13.—Component Parts of Motor Pump.

wound with a single length of conductor, the only joint inside the motor being at the star point, which is covered with a special rubber insulation and vulcanised, so that the insulation of the windings is continuous throughout. The ends of the stator windings pass through a water-tight gland in the motor case, and are sometimes attached to a watertight cable coupling fixed to the motor case, while in others they are

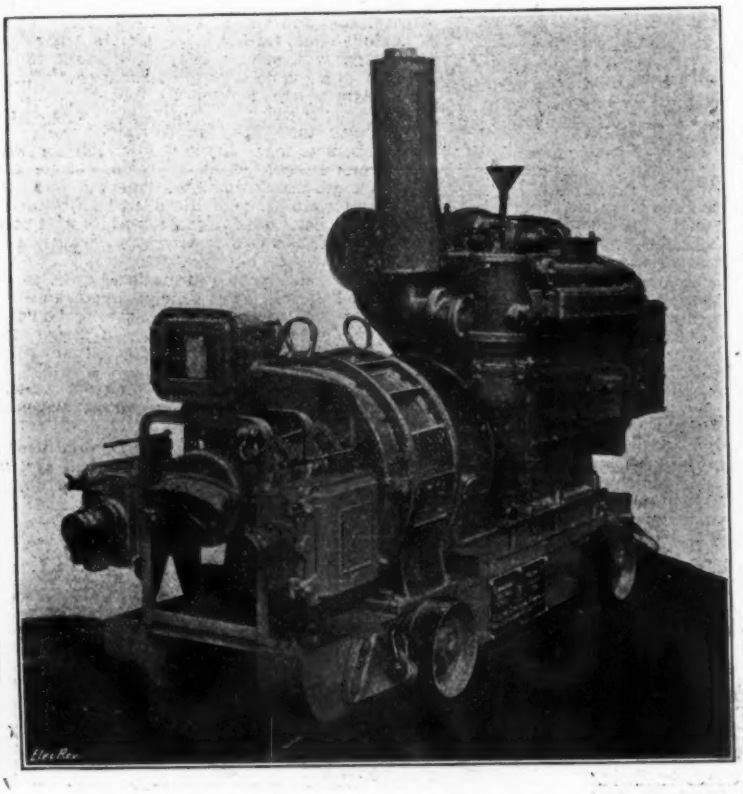


Fig. 14.—Weather-proof Generating Set.

brought out for a distance of 50 ft., and protected by armoured hose, a cable coupling being fitted at the end. Samples are shown of the cable couplings, fig. 15. These were designed to withstand the severe conditions met with in marine salvage operations and in mining work.

An oil-engine driven generating set for operating submersible motors is shown, fig. 14. It consists of a weather-proof alternator and exciter of 35-k.v.a. capacity, coupled either to an Allen, or to a Thornycroft weather-proof engine, running at 750 r.p.m. The set is mounted on a wheeled truck fitted with lifting shackles, so that it can be easily moved about. On the set with the Allen engine a weather-tight switchboard, figs. 14 and 17, is fitted carrying the necessary switches and instruments for controlling two 4-in. submersible motor-pumps. A large number of the portable generating sets were supplied during the war to the Admiralty for dockyards and salvage vessels, as well as to the Allied Navies.

As up to the present the electric supply on ships both in the Navy and mercantile marine has always been on the d.c. system, and as submersible electric motors require 3-phase current, it is necessary to employ motor alternators or rotary transformers for the purpose of converting the d.c. to 3-phase a.c.; an example of these is shown, fig. 16. A special feature

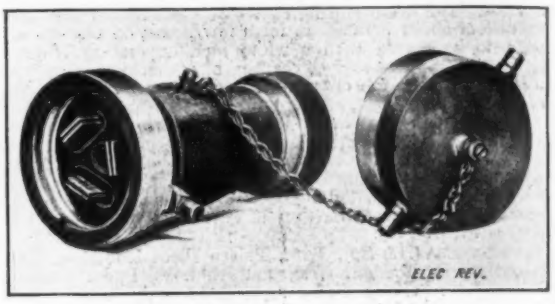


Fig. 15.—Water-tight Cable Coupling.

in the design of the 17-k.v.a. rotary transformer is that it can be run in either a vertical or horizontal position, which is a great advantage when the location of this on board ship has to be decided.

Another interesting exhibit is the submersible saw for cutting metal, which consists of a circular saw driven through gearing by an electric motor; electro magnets are provided for attaching the saw to the work. It is intended for use in marine salvage work, and can be controlled by the diver himself while under water.

A range of very substantially built foot valves for use in connection with the motor-pumps forms another exhibit. A special feature in the design of these is the internal sleeve reaching nearly to the bottom of the strainer, which permits water to be drawn to within an inch or two of the bottom on which the foot valve rests. The strainers have an area well above that of the area of the pipe, a point often overlooked in the design of these fittings.

Fig. 16.—A 17-k.v.a. Rotary Transformer.

A small silent running d.c. electric motor with propeller, shaft and thrust bearing for use in electric canoes and launches is also shown.

In the large yard two 4-in. submersible motor-pumps are shown at work under full load conditions. One is submerged and delivering water to the full height of 75 ft., and the other is working with a suction lift of over 30 ft., which, it will be noted, is an exceptionally good performance for a single-stage

centrifugal pump. These pumps are driven by one of the generating sets with an Allen engine referred to above.

It is beyond question that the most convenient method of driving the various machines employed in mining work is by means of electric motors. The damp atmosphere which prevails in the workings of all mines will break down an ordinary electric motor if accidentally immersed or flooded by the sudden inrushes of water, which so frequently occur. The submersible electric motor being designed to operate with water flowing through it, will work in the dampest atmosphere or entirely sumberged for an indefinite period. It can be used to drive pumps, air compressors, rock drills, coal cutters, and for any other purpose for which motive power is required. In combination with a centrifugal pump, it

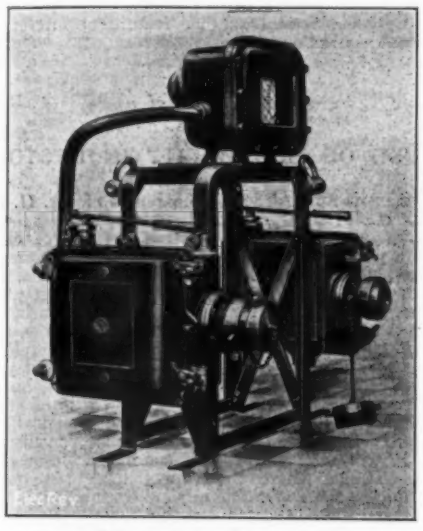


Fig. 17.—Weather-proof Switchboard.

forms an exceedingly compact piece of apparatus, easily moved to any part of the mine as occasion requires. A number of pumps can be attached to the same motor, in order to give the required height of lift, a lift of approximately 80 ft. for each pump being obtained, thus a three-stage pump would deliver to a height of 240 ft., and a six-stage pump to a height of 480 ft., and so on.

In pumping the plant can be placed at the bottom of the mine, and where it can be submerged no suction piping is necessary, simply a delivery pipe being taken to the point where the water is to be discharged. In a flooded mine the motor pumps can be suspended by chain slings from overhead tackle, immersed a few feet under water, and lowered as the water level is reduced, extra lengths of delivery hose being added as the pumping proceeds.

In some coal mines the presence of inflammable gases renders the use of electric motors impossible, owing to the danger of explosion; with the submersible motor, however, this is entirely done away with, as the whole motor being surrounded by water, no sparking whatever can occur.

The Electrical Apparatus Co., Ltd., South Lambeth Road, S.W., has an interesting exhibit. This firm specialises in the manufacture of motor-control gear of all kinds, ironclad switchgear and electricity meters, and the various types of manufactures are well represented. The apparatus shown may be classified under four main headings:—

The D.C. control gear includes a 6-H.P. motor panel of the standard type, comprising a two-pole switch and fuses, and face-plate starter fitted with the usual automatic features, mounted on an angle iron frame.

The commercial type starter of the semi-enclosed pattern is provided with no-volt and overload trips, and is suitable for a 10-H.P., 220-volt motor.

A complete portable panel, suitable for a 20-H.P. motor, and contains a D.P. switch and fuses, starter, shunt field-regulator, ammeter, voltmeter, and wattmeter. The starter embodied in this panel, however, is of the firm's patented slow-motion type. The slow motion is attained by a pawl carried on the starter lever moving in a guideway provided with alternate camming and arresting shoulders. The starter allows a quick forward movement, but provides dead stop on the centre of each segment, so that it is impossible to start up the motor too quickly. The backward movement, however, is not impeded. The resistances are rated for a starting period of 60 seconds.

An inching type pillar panel for a 14-H.P. motor is specially designed for the heaviest service, and is suitable for the control of printing presses, heavy machine tools, and all purposes where frequent starting and stopping under load occurs. A few of the features embodied in this starter are: The absence of a main "pull-off" spring and "hold-on" coil. Independent no-volt and overload releases, operative in any position of starting or running; the overload release is of the circuit-breaker type. The circuit cannot be broken on the starting segments; it is impossible to move the main lever backwards without first causing the contactor to open the main circuit. The motor can be "inched" or started and stopped as frequently as may be desired; it can only be started with all resistance in circuit. The contactor coil cannot be burnt out by staying too long on the first step. The only insulation on the starter proper is a 0.75-in. thick ebonite bush, not subject to mechanical strain. In order to demonstrate practically the performance of the starter it is arranged to control, on the stand, a 14-H.P., 220-volt, Crompton motor, coupled to a Heenan & Froude dynamometer. By means of this the motor can be loaded up as desired, and the behaviour fully demonstrated under all conditions of load. In addition to the inching starter in operation, two other examples, together with contactor boards, showing the constructional features of the apparatus, are on view.

A multiple-lever starter for a 50-H.P., D.C. motor is made on the same liberal lines as the firm's inching starter, and is recommended for use where sliding contacts become too large for convenient hand operation. The same arrangement of contractor and automatic releases as in the inching starter are embodied, and the various levers are mechanically interlocked so that they can only be operated in proper sequence.

The series relay starter is a new form of automatic starter, so designed that the rate at which the starting resistance is cut out, is dependent upon the rate of acceleration of the motor; it consists of an electro-magnetic master device, which controls the operation of a number of contactors in such a manner that they can only close in correct sequence and cut out the starting resistance step by step. By the provision of a specially designed pendulum movement, on the master switch, however, it is impossible for any step of the resistance to be cut out in less than a predetermined period which is sufficient to preclude any possibility of damage to the motor which it controls.

Examples of shunt field regulators used for motors, dynamos, &c., are of the usual form, but the resistance material employed is non-corrodible and has a negligible temperature co-efficient.

The A.C. motor-control gear includes faceplate starters suitable for three-phase induction motors of 40-H.P. and upwards. Several typical starters are shown with and without overload and no-volt releases, and of the open and totally enclosed patterns. In addition to the various faceplate starters referred to above, this firm has developed a complete series of drum-type control gear for A.C. motors, contact fingers and drums of a standard pattern being used throughout the whole series, both in the oil-immersed and air-break patterns. The exhibits of this firm include auto-transformer starters, star-delta switches, rotor starters with step-by-step, slow-motion device, and combined stator and rotor starters, with automatic trips, which form a complete controlling unit for induction motors.

Four examples of A.C., ironclad, oil-immersed, H.T. switches are shown, so designed that they can be used alone or in combination with others to form distribution panels, or with starters to form motor-control panels. To demonstrate this flexibility, two panels are shown mounted together, and provided with a bus-bar forming a two-panel distribution board; one is mounted on a pedestal with a drum-type rotor starter, and the other is arranged to show constructional details, tank lowering gear, and draw-out isolating features. The same form of contact finger and switch drum are used as in the drum-type control gear. The general appearance of these switches is very distinctive, and points particularly noteworthy are mechanical strength, simplicity of design, the mica and metal construction, and accessibility of all parts when opened up for inspection.

Several sizes of the firm's well-known A.C. and D.C. meters are shown, together with component parts in various stages of manufacture.

Messrs. Arthur Lyon & Wrench, Ltd., 36, Victoria Street, Westminster, S.W.1. The "Lyon-Brotherhood" patent system of domestic electric lighting has been designed with the object

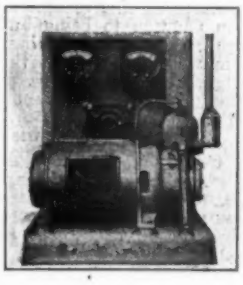


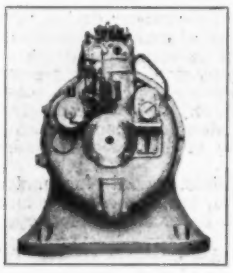
Fig. 18.—A 24-volt House-lighting Set.

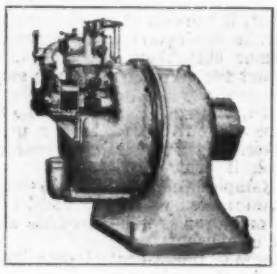
Fig. 19.—A 50-volt Farm-lighting Set.

of bringing the numerous advantages of electric light within the reach of even small householders, and is a peace-time production embodying the successful results of four years' war work. The system is "domestic" in the strictest sense of the word—any unskilled person can run it quite success-

fully. In the "Popular" set the engine is self-starting, as in modern motor car practice, by the simple movement of a lever; no regulation is necessary during battery charging.

By the use of large ball bearings for the main shaft, with hardened steel and phosphor bronze bearings in the connecting rod, wear and tear is reduced to a minimum. For example, the "Popular" 24-volt set, using standard ¼-watt lamps, will light a 12-roomed house at a fuel-running cost averaging about 2s. a week. The domestic lighting sets are made in two types: 24-volt "Popular" type, capacity 36 to 72 lights (using ¼-watt lamps); and 50-volt "Major-Domo" type, capacity 100 to 150 lights. (Larger sizes on application.) The lights refer to the total number of lamps installed, and the output of the plant is calculated on this basis: that two-thirds of the total lamps installed are of 20 c.p. (for living rooms, &c.) and the balance (one-third) of 8 c.p. (for small bedrooms, &c.). The liberal capacity of the storage battery allows of an eight hours' consumption of one-third the number of lamps installed, without recharging. In actual practice, on an average throughout the year, the engine will only need to be run about four hours per week. The 24-volt "Popular" type of outfit is shown in fig. 18, and is suitable for lighting premises with from 10 to 15 rooms. It comprises a petrol engine (Ricardo patents) combined with a dynamo and mounted on a self-contained, cast-iron, water-tank base,





Figs. 20 & 21.—The Lyon-Brotherhood Power Unit.

and is complete with a self-starter, switchboard, fuel tank, and a 75 to 150 amp.-hrs. battery. These sets, made in four sizes to supply from 36 to 72 lights, occupy a space (excluding battery) of only 20 in., by 21.5 in., by 30 in. high.

The "Major-Domo" 50-volt type, 100 to 150 lights, occupies a space (excluding battery) of 20 in., by 28 in., by 26 in. high, and is suitable for country houses, farms, &c., giving a reserve of power for heating. The set is shown in fig. 19; the petrol or paraffin engine, fitted wilth overhead valves, is direct built into a 50-60 volt dynamo. A switchboard with all instruments, also fuel and water tanks, piping and fittings, and a 100 to 150 amp.-hrs. battery is supplied with the set. Both these sets can be supplied for higher voltages where it is required to install the engine some distance from the house. The "Lyon-Brotherhood" power unit, 3 to 8 h.p., is shown in figs. 20 and 21; the engine is semi-portable, and takes up very small space. The consumption is under 2/3 pint of petrol per h.p. hour, and the engine can be fitted with a paraffin vaporiser if required.

This firm also exhibits d.c. motors and dynamos, a d.c. motor-generator set, as adapted for running a kinematograph projector arc lamp, complete with starter and regulator, L.W. d.c. motors in three frame sizes with starters, a positive type rotary pump and L.W. motor drive, and samples of component parts of various manufactures are also on view.

British Electric Vehicles, Ltd., 126, Hamilton House, Bishopsgate, London, E.C. 2, exhibited an accumulator industrial truck and a battery locomotive or tractor which will haul 10 tons on the level or 3 tons up a gradient of 1 in 30. These trucks, which have been described in our pages from time to time, are manufactured in five different standard patterns and capacities, in addition to being built to meet special requirements when so desired. The hard-working merit of B.E.V. trucks is well known, and they are most economical in upkeep, it being claimed that ½d. per hour is approximately their running cost. They are also practically "fool-proof," so that those totally unacquainted with machinery can with safety be entrusted to operate them.

The Electro-Mechanical Brake Co., Ltd., Eagle Works, West Bromwich, exhibited a collection of grid resistances and component parts. The E.M.B. resistance is guaranteed unbreakable, and as the grids are made in one continuous length, the difficulties of maintaining good contact at the ends of the grids, due to corrosion and loss of pressure on the contact surfaces, resulting from vibration and expansion and contraction, are claimed to be overcome. For use in chemically-laden atmospheres the grids can be supplied with lead coating or arranged in fume-proof boxes. Grids of E.M.B. unbreakable, jointless and rustless type resistances are in one continuous length per section, the wire is of uniform cross section with temperature coefficient and carrying capacity similar to that of cast iron, the shape of the grid is such as to secure stiffness and prevent the possibility of adjacent grids touching each other through vibration. The insulation is mica and micanite throughout, the grid bolts passing through micanite tubes and the grids separated by washers of pure mica. A test to 3,000 volts a.c. is applied before despatch. Secondary mica insulation at the ends of the grid bolts is supplied for high voltage. The terminals are of the mechanical type, with split head set screw, lock nut and lock washer; they are of high quality gunmetal of substantial section and current-carrying capacity, capable of being attached directly to the loops at the ends of the resistance grids without disturbing the grids themselves. The frame is of pressed steel flanged and sufficiently heavy to secure rigidity, and the covers are of small mesh expanded metal stiffened with wide beading of steel strip at the edges.

The Medway Safety Lift Co., Bolt Street, Deptford, London, S.E. This exhibit consists of one of the firm's latest type of electric passenger lift and safety locks and switches which can be seen in operation. These latter are claimed to be fool-proof, and ensure perfect safety. The lock exhibited seems to be reliable, and another feature of interest is the firm's patent controller.

(To be continued.)

THE USE OF ELECTRICITY IN FACTORIES.

The following is an abstract of the report of Mr. G. S. Ram, M.I.E.E., H.M. Electrical Inspector of Factories:—

The outstanding feature as regards the use of electricity during the period of the war is the enormous increase that has taken place due to the requirements of works engaged directly or indirectly on the output of munitions of war. The extensions of public supply generating stations have been chiefly in the form of enlargement of existing works, although about ten entirely new stations have been completed and put into use during the period under review. They are all equipped for extra-high-pressure 3-phase systems, on modern lines. Three large generating stations and a number of sub-stations have also been completed for the electrical working of sections of railways. It is expected that considerable developments will take place when conditions become normal in those districts where the supply has been necessarily curtailed during the war. The scheme contained in the report of the Board of Trade Committee on Electric Power Supply may eventually lead to great economies in the matter of fuel, but it cannot be carried out all at once and extensions of many of the existing smaller stations will be imperative in the meantime, if developments in the use of electrical energy are not to be retarded.

Considerable anxieties have been experienced by those responsible for running electrical stations owing to shortage of labour. Women were widely brought in for varied work; before the war few people would have thought it possible that women could have successfully undertaken the work of attendants in important sub-stations for converting from high tension 3-phase supply to direct current for traction or general distribution. Experience has, however, shown that the trial was justified, excellent reports of the capabilities and resourcefulness of the women having been received, naturally, however, with certain exceptions.

A number of new factories have been erected during the war by or under the control of H.M. Ministry of Munitions, and many of them have been provided with their own electrical generating stations and sub-stations. These have been for the most part well designed and equipped with modern and up-to-date plant. New generating stations have also been erected by several private firms, and many others have been extended. Generally, the new work has again been good. An important matter, which I have pointed out on previous occasions, had, however, been overlooked in several instances. In stations intended to maintain a continuous supply, night and day and on Sundays, medium-pressure 3-phase switchboards have been so arranged as to make it impossible to carry out any work, *e.g.*, overhaul of an oil switch, in safety. No isolating switches had been provided between the bus-bars and the oil switches, and no divisions between the panels. This arrangement has been found on the main switchboards where the supply has been at medium pressure and in high-pressure stations in regard to the medium-pressure auxiliary switchboards. These switchboards controlling all the auxiliary plant in the station, *e.g.*, condenser pumps, feed pumps, mechanical stokers, &c., are just as important as regards maintenance of the supply as the main switchboards. In other cases both isolating switches and divisions were satisfactorily provided. In one large station for an electric railway the matter had been dealt with in another way, the auxiliary switchboard being duplicated, so that either one could be completely shut down when necessary, every motor in the station having a cable from each switchboard with a change-over switch at the motor—an excellent arrangement, although no doubt somewhat costly.

During the period under review I have visited a number of explosive works and filling factories, most of them, of course, being new works. In general, the electrical work has been well done, special precautions being necessary on account of explosive risks or liability of damage to wiring and apparatus from acid fumes. "Danger" buildings have where possible been lighted entirely from outside, motors and all switchgear, fuses, &c., being either in separate buildings or in rooms completely shut off. In some the lighting has been necessarily inside, special well-glass or bulkhead types

of fittings being used. Motors, where inside, have been pipe-ventilated or provided with forced-draught ventilation with spray-washed air. The work was, however, much better done in some cases than in others, and some otherwise good work was rendered dangerous by not being properly finished off. Thus I found pipe-ventilated motors with no pipes connected, and even forced-draught motors with no pipes on the outlet, in buildings with highly inflammable if not actually explosive material near by, where the effect of a burn-out of an armature would be to blow a torrent of sparks into the room. Slackness in maintenance was also sometimes noticed, well-glasses of lighting fittings having been broken and not replaced. The soundness of the work in general is, however, evident from the fact, confirmed by H.M. Chief Inspector of Explosives, that in no case was any explosion or fire attributable, so far as could be ascertained, to any electrical installation or defect therein.

Amongst the heavier uses of electrical power, several new steel rolling mills have been put into commission. A rolling mill provides probably the most severe test of electrical machinery possible, and the fact that more mills are being equipped electrically is a sufficient proof that the method is reliable, and has other advantages over steam power. The extremely heavy load being suddenly applied to the motor necessitates enormous mechanical strength in all parts. Motors of 5,000 H.P., giving 10,000 or 12,000 H.P. for short intervals on the peak, are in use. In some mills the handling of the steel, from taking the billets from the soaking pits to the rolls and passing them backwards and forwards through the mill and finally taking away, cutting up, and stacking the finished sections, is accomplished entirely by electrical power. Most of the mills are reversing, the motor having to start, come up to speed, slow down, and reverse perhaps ten times a minute. Some are not reversing, the motor driving the rolls constantly in the same direction, the steel billet passing one way above and the other way below the live or driven roll. Some have a direct drive, others are geared, and some of the smaller ones are rope driven. In order to equalise the power taken from the supply source and prevent the enormous fluctuations, which would otherwise be experienced, full use is made of the storage of energy in flywheels. These are attached in the case of reversing mills to motor generator sets intervening between the source of supply and the mill motor, and in the case of non-reversing mills to the driving shaft of the rolls. The electrical control systems naturally appear somewhat complicated, and are specially designed to reduce electrical losses to a minimum, and are provided with various safeguards in case of accident. Other new heavy-duty motive power plants with intermittent loads include large hoists for dealing with loads of 40 or 50 tons, as for blast furnaces, fully loaded railway trucks being taken up and tipped directly into the furnaces.

Perhaps the most striking development in the direct use of electrical energy has been for furnace work, principally in steel manufacture, for the making of high-grade special steels and alloys. Several patterns of furnace are in use, all taking alternating current, single-phase, two-phase, or three-phase. The sizes of the furnaces are mostly from half a ton to ten tons capacity, although there are a few still larger. In the smaller sizes they are arranged to be regulated by hand, and in the larger sizes, during the first part of the process, while the steel is being melted, after which the regulation is automatic. Success in their use depends very much on having skilled attendance, electrical as well as metallurgical, and some of the more important works have found that it pays them to employ an electrician in charge of each furnace. In many works, however, there is no such skilled electrical supervision. With most patterns of furnace the pressure used is about 90 volts for melting, being subsequently reduced to about 70 volts by means of selector switches connected in the primary side of the transformer windings. The main supply is of course at high tension, in many cases at 11,000 volts. Unfortunately the equipment of the transformer rooms in many instances had been carried out in a dangerous manner. In many cases the apparatus was badly arranged and the protection of the high-tension conductors was totally inadequate, these being treated as of no more consequence than if at 100 volts.

Similar furnaces are also being tried for brass making and casting, but direct heating by the arc appears to present some difficulties. Arc furnaces are also used in the manufacture of calcium carbide, phosphorus, carborundum, sulphate of lead, &c., some being on a large scale, others comparatively small. Electric resistance furnaces are also being tried for the making of crucible steel by heating the crucibles from the outside. Hardening furnaces, in which the current is passed through a bath of salts, are used for hardening tools. These are comparatively small, and the primary current supplied to the transformer may be only, say, 200 volts.

Electric heating has also been developed in several new directions, among which may be mentioned that of cardboard box manufacture.

Other new plants for the direct use of electrical energy include some for electrolytic manufacture of certain explosives, and of chlorine and oxygen, and for the recovery of tin from scrap. At least one plant was installed for the manufacture of nitric acid by obtaining nitric oxide from the air by means of the electric arc. Several installations have been put up for depositing fumes and dust by means of high-tension electrical discharge.

The use of electricity in welding has increased very much during the war. There is danger in case of a breakdown of the insulation of the transformer causing the welding jaws and the metal being welded to become charged at the pressure of the supply circuit, generally 200 to 400 volts and, as recorded in some of my previous reports, fatal accidents from electric shock have occurred in this way. This danger can be overcome by earthing one point of the secondary circuit. I have found a number of welding machines in different works, notably for the welding of chains, where serious dangers existed through exposure of conductors, terminals, switches, &c., of the primary circuits.

A considerable development has also taken place in electric arc welding, chiefly with metallic electrodes. Owing to the injurious effect of the rays from the arc upon the eyes a screen of darkened glass is always used, it being impossible to work without one. It is also necessary to protect the skin of the face, neck, arms, &c., both from the rays and from particles of hot metal. A point of some difficulty is that the glass has to be so dark that practically nothing but the arc and the hot metal immediately round it can be seen. In addition to reducing the luminous rays to an intensity which will not hurt the eyes, certain invisible rays both in the ultra-violet and infra-red must be cut out. Usually two coloured glasses, ruby and blue, are superimposed, or sometimes ruby and green with a third of neutral tint. Different workers favour different combinations, but the matter is one which appears to warrant further scientific research. In welding in a fixed position as in a workshop, a screen with darkened window is usually held in one hand by the worker, who manipulates the electrode with the other. As injury may be caused to the eyes by looking at the arc from some distance away, even for only a few seconds, it is necessary also to surround the working places with opaque screens to prevent the rays reaching other persons in the vicinity or who may be passing. For working in confined spaces or in positions where the left hand may be required for use or for holding on by, a mask with a darkened window is sometimes used. This window is conveniently hinged to allow of its being opened so that the worker may see his surroundings when not actually welding. A protective tunic with mask, completely screening the upper part of the body, devised by one firm, provides that the welder can only see directly in front, and he is consequently protected from the rays of any adjacent arcs which may be used by other welders. Such masks or helmets are not, however, liked by the workmen, who prefer to use the hand screen whenever possible.

With direct current the danger through electric shock is very slight, and probably negligible, except perhaps as regards persons working on stagings or in confined spaces, and it should therefore always be used where possible. With alternating current there are dangers which have to be guarded against, because it is in any case more dangerous than direct, and also because a person holding a live conductor and getting a shock through his body will in general be unable to release himself. It is therefore very necessary that the electrode holder shall be so constructed that it shall be impossible for the worker to touch any live part with his hand whilst holding the handle. I have found in use many electrode holders which do not comply with this elementary requirement. Another important matter is that one pole of the circuit, that which is connected to the article to be welded, shall be efficiently earthed. Where this is done the only danger point, assuming that the flexible conductor is properly insulated and protected, and the resistances, &c., are properly guarded, is the electrode holder and the electrode. There should, of course, be no switch or fuse in the earthed conductor. Except when the arc is actually maintained, the electrode is at the full pressure of the circuit. When the welding is done in a workshop the welder is usually close to the switch controlling the circuit, and can readily cut off the pressure when he has finished or when he requires to renew the electrode. In other cases he may be at a considerable distance from the switch, and it has been suggested that there should be an auxiliary low-voltage circuit in the flexible cable, with a push-button thumb-switch in the handle of the electrode holder, arranged to operate a contactor switch at the fixed end of the circuit. The electrode and holder would then normally be dead and would only be made live when actually put to use.

Considerable study has been given to the question of lightning protection at many explosive works, and, in some, care had been taken to connect together all metal work within or about the buildings, with the idea of eliminating all possible points between which any spark discharge due to secondary effects of lightning could possibly occur. This precaution is probably very sound, and might be more generally adopted in other cases. Except for chimneys, lightning protection is seldom provided on ordinary factory buildings, no doubt due to the risk of damage being regarded as very remote.

Much consideration has been given during the last few years to the science of illumination and to the design of efficient fittings for distributing the light to the best advantage according to the special circumstances for which it is required, the matter having been of special importance during the war owing to the large amount of overtime and night work resorted to in many works. For many years factory lighting by electricity was dependent upon the arc lamp for general illumination, with the attendant troubles of trimming, cleaning and the expense of carbons, and upon the carbon-filament glow lamp of very low efficiency for localised lighting of

individual machines, work benches, &c. This localised lighting necessitates a large number of pendants, brackets, or other fittings wherever the lights are required. The improvements which were effected some years ago in gas lighting would probably have led to gas largely superseding electricity for factory lighting, had not the metallic-filament glow lamp with its corresponding improvements been introduced just in time to re-establish the relative advantages of the latter. Half-watt lamps are made in sizes up to 1,000 candle-power, so that it is now possible largely to dispense with localised lighting by providing a comparatively few of these lamps suitably placed. At the same time there have been useful developments in localised lighting. One which is particularly suitable for engineering machine shops, provides for small ten-watt lamps, such as are used in motor car head lights, in specially designed reflectors attached to fittings having universal joints so that the lamps may be put in any position. The pressure is only 10 or 12 volts, being reduced from the supply pressure by a small transformer for every ten or fifteen lamps. The wiring is concentric, the metal tubing of the fittings forming the return conductor and being earthed at the transformer. This construction, of course, greatly simplifies the mechanism of the universal joints. Besides being very robust, and therefore suitable for machine shops, the advantages claimed are excellent lighting of the work, as much as 15 foot-candles being obtained at 15 in. from the lamp, economy in the amount of electrical energy consumed and particularly in regard to lamp renewals, the small lamp successfully withstanding the inevitable vibration and rough usage under conditions which would be disastrous to lamps of ordinary pressures, say, 200 volts, with their far more delicate filaments. A further advantage is no doubt in safety on account of the very low voltage. Some excellent examples of modern scientific lighting are to be seen in some of the new works. On the other hand, I have seen instances of very bad lighting with half-watt lamps, the lamps being unscreened and placed where they cause a glare, and are probably harmful to the eyesight of persons employed. Similar unscientific and harmful examples may be seen by anyone in many of the shop windows of the West End at the present time; unshaded lamps are placed so that they shine into the eyes of the onlooker, causing such a glare that they fail utterly to show up the goods in the window although in a blaze of light.

Except as regards districts which have been supplied for many years with direct current, the development in the use of electrical power is mostly by alternating current, 3-phase or 2-phase, which from the point of view of electric shock risk at low voltage is very much more dangerous if proper care is not taken. As distribution at high pressure is becoming more general in manufacturing districts, transforming sub-stations have often to be provided on the factory premises even for small consumers.

In some cases otherwise good installations are spoiled by not being properly finished off. The most prevalent fault in this connection, which I have referred to in previous reports, is that even though the conductors are well protected in screwed steel conduits throughout almost their entire length, the conduit is not taken right up to switch boxes or motor terminal boxes, so that loops of unprotected cable are left, often in positions where they are liable to damage, *e.g.*, on the floor at the motors. This is partly due to the slight extra cost of providing switch and fuse boxes and motor terminal boxes having properly made sockets for the attachment of the conduit. Several large manufacturers supply their motors without any terminal boxes, cable tail ends being brought through the casing for connecting up to the circuit, instead of providing terminal boxes with facilities for connecting up conduit, although they will supply them at an extra charge.

Owing to the great expansion in the use of electrical energy during the period under review, it might have been expected that the number of electrical accidents would have increased. This, however, was not the case. Mr. Wilson, superintending inspector, Glasgow, states:—

"Notwithstanding the greatly increased use of electricity both in power and light, there have been remarkably few electrical accidents throughout the division, and this is attributed chiefly to the fact that the plant introduced complies with the requirements of the regulations. Practically all the inspectors are agreed on this satisfactory feature of the new installations."

On the other hand, the number of fatal accidents has somewhat increased, 99 having been reported in the four years, as against 70 in the previous like period, 1911-1914. Of these 99 fatalities, 14 occurred in electrical stations of public supply or traction undertakings, the remainder on ordinary factory premises. In addition to these there were four fatalities indirectly due to electricity. One was caused through explosion of gas from a secondary battery by electric spark, one through failure of the current of a crane magnet allowing the load to fall on a man, one from burns where a girl got her dress set on fire by knocking the lead out of a terminal of a motor, and the other from burns where a man short-circuited conductors with a benzine blow lamp.

It will be seen from the table that 95 out of the 99 fatalities occurred with alternating current, 19 being on systems of less than 250 volts, whilst 47 occurred on three-phase systems from 346 to 440 volts, but where the pressure to earth would not exceed about 250 volts, most of the systems having the neutral point earthed. Many of them occurred on lighting circuits taken from one phase and the neutral. In three or four cases only is it likely that the shock was received from contact with two of the phase conductors, the accidents being nearly all due to contact with one conductor only, the currents passing through the victim to earth. Three direct-current cases were on medium-pressure traction systems having one pole earthed. In the case of the solitary low-pressure direct-current accident death was probably due to the fall. In several of the cases where the accidents were due to absence of, or ineffective, earthing, the actual pressure received may have been considerably less than the maximum voltage of the circuit.

The importance of artificial respiration as a means of resuscitation in cases of apparent death from electric shock, although generally appreciated by electrical engineers for many years past, is not adequately realised by factory occupiers or even by many members of the medical profession. Instructions on the matter are required to be posted in all works using electrical energy above low pressure. Information as to what was actually done was recorded as regards 50 of the foregoing fatalities. In 15 cases artificial respiration was carried on for an hour or longer, in some instances under

FATAL ACCIDENTS 1915 TO 1918.

Fatalities.	Voltage of system.	System.	Fatalities.	Voltage of system.	Probable voltage of shock.	System.
			32			
1	12,000	1 phase	†29	440	250	3 phase
6	10,000 to 11,000	3 "	*15	400	230	3 "
1	6,600	1 "	1	365	210	3 "
4	6,600	3 "	2	346	200	3 "
2	5,000	3 "	1	240	240	1 "
1	3,000	3 "	*1	230	230	direct
1	3,000	2 "	1	225	225	1 phase
2	2,000	2 "	2	220	125	3 "
1	1,600	1 "	*6	220	220	1 "
1	1,000	1 "	7	200	200	2 "
*9	500 to 550	3 "	1	200	‡65	2 "
3	500 to 550	direct	1	105	105	1 "
32			99			

* One case fall following shock. † Three cases fall following shock.
‡ Measured pressure.

medical supervision, in ten cases for half an hour, in eight for 15 minutes, in two for 10 minutes, in one for 5 minutes. In six of the 15-minute cases the doctor who was called in pronounced life extinct at the end of that time. In four others no mention is made of the length of time, but the efforts at resuscitation were carried out "until the doctor arrived." In ten cases artificial respiration was tried, but no mention is made of the duration of the effort. In four cases it is definitely recorded that no artificial respiration was tried, in one even though a doctor arrived shortly after the accident. In eleven cases, therefore, where a doctor was on the scene within a few minutes of the accident, practically no attempt was made to revive the patient. This indicates that the medical profession generally is woefully ignorant on the matter. That enlightened medical opinion is convinced of the efficacy of treatment by artificial respiration is well known, and in support of this statement I again refer, as in my report for 1912, to a letter which appeared in *The Lancet* by Dr. Reginald Morton, President of the Electro-Therapeutics Section of the Royal Society of Medicine, in which he stated that "death from electrical shock is only an apparent death at first, and whatever the conditions or severity of the accident, there is practically always a time, varying from a few moments upwards, during which it is possible to resuscitate the victim by artificial respiration if resorted to at once. Artificial respiration must be persevered with for at least two hours, or until the patient revives; in many cases it may be only a few minutes."

Amongst the non-fatal accidents for the period particulars are available of three cases where the victims were insensible and were brought round by artificial respiration. It is to be hoped that the "safety first" movement, which is now gaining ground, will lead to more general training of ambulance men at all classes of works in the methods of artificial respiration, so that victims of electrical shock may in more cases receive prompt and adequate treatment, and thus be given at least a chance of recovery.

Midland Electrical Engineers' Ball.—It has been decided to revive the Midland Electrical Engineers' Ball, which will be held at the Grand Hotel, Birmingham, on Thursday, November 13th, 1919. Mr. R. A. Chattock has kindly consented to act as chairman, Mr. W. Y. Anderson as hon treasurer, and Mr. G. J. Bish, of 55, Newhall Street, Birmingham, as hon. secretary. Tickets may be obtained from either of the foregoing. The services of Joyce's London Band, personally conducted by Mr. Archibald Joyce, have been secured, and it is anticipated that the occasion will enable many old friends to meet again, as, owing to the war, it has been impossible for the past five years to hold the ball. All electrical engineers are urged to attend, in order that the function may prove to be as great a success as those which have preceded it.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Prido Adjustable Reflector.

A new adjustable lamp shade and carrier suitable for general use is being placed on the market by Messrs. Prideaux & Co., Ltd., of Macdonald Street, Birmingham. The design of the reflector, which is made of aluminium, can be seen from fig. 1, and it is claimed that without reducing the reflective power, the shade can be tilted to a variety of angles, so as to both shade the eyes and direct the full

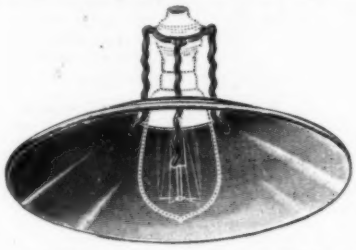


Fig. 1.—The Prido Adjustable Reflector.

light on to the work. Without sacrificing efficiency, considerable saving in current can be effected; low c.p. lamps can be used. Being of metal, the shades are not liable to breakage as with opal and glass shades, and besides saving on the lighting bill the initial cost is low. The standard pattern is made 10 in. in diameter.

Hunt Electric Trucks.

The "Hunt" industrial storage-battery trucks, of which the sole agents for the United Kingdom are Messrs. Irwin & Jones, Ltd., London House, New London Street, E.C.3, are made in three types, but are all of the same carrying capacity, viz., two tons. The "A" type truck is the type mostly in use, and has a platform area of 30 sq. ft., a maximum width of 4 ft., loading platform 23 in. from the ground, and a turning radius of 7 ft. 3 in., measured from centre of truck. The "B" type truck is similar in design and construction to the "A," but has a platform area of 40 sq. ft., a maximum width of 4 ft., loading platform 24 in. from the ground, and a turning radius of 10 ft., measured from centre of truck. The "DF60" truck is a special design, having a four-wheel steer, and has a platform area of 15 sq. ft., loading platform 11 in. from the ground, and a turning radius of 5 ft. 8 in., measured outside wheels.

Our illustrations show two useful trucks; fig. 2 shows a quick end-dumping coal truck with a carrying capacity of 60 cu. ft., and fig. 3 shows a side-dumping body in position for dumping. With regard to the constructional details of the "A" type truck, the platform is constructed of 1¼-in. seasoned oak with rounded corners reinforced by angle irons; the upper surface of the platform is further protected with metal strips, and is divided and hinged for easy accessibility of battery and all mechanical parts. The frame is made up of 4-in. channels, making the truck extremely rigid and preventing twisting and distorting which would impair the alignment of the bearings and motor. The truck is driven through a differential made up of cut steel gearing, which, together with the motor pinion, is enclosed in an oil and dust-proof housing; all of the rotating parts run in flexible or self-aligning S-K-F ball bearings with lubrication amply provided for. The rim and web of the wheels are of cast steel, made in one piece; the wheels are mounted on Timken roller bearings, which are well lubricated and protected from dust and dirt. The tires are solid rubber, with 3½-in. face and 20 in. outside diameter, and are of the demountable type, easily detached and renewed. The brake consists of a flexible steel band, lined with asbestos, encircling a drum on rear wheels, is spring actuated, and is always set unless the pedal on the operator's platform is pushed down. In driving the car, the operator merely keeps one foot on this brake pedal; thus, when not in operation, the truck is always locked. A cut-out switch connected to the operator's platform automatically breaks the electrical circuit when the operator steps from the platform. The truck is steered by means of the right-hand lever on the front end, which operates vertically, and is direct connected to knuckle joints, located on the forward axle. The wheels can be turned short enough to permit the truck to enter a standard box-car and be turned toward either end. The knuckles are provided with grease cups for lubrication.

The battery box is of heavy gauge sheet steel and suspended by springs from cross members of the frame. The entire section of the top of the truck over the battery box is hinged, thus making all of the batteries readily accessible. Either Edison iron and nickel cells or Exide lead cells can be supplied. The equipment consists of 36 Edison cells, type A-4, 150 amp.-hour capacity, 43 volts or 20 cells, type MVII ironclad Exide, 158 amp.-hours, 40 volts. The cells are mounted in trays and are easily and quickly removed at will; the Edison cells require 30 amperes for seven hours to charge fully and ironclad Exide cells from 15 to 30 amperes for 6½ hours. The batteries can be charged from any d.c. circuit through a suitable charging resistance, or from an a.c. circuit by means of a current rectifier. The charging plug is of the removable safety type which can be inserted in one position only; one 150-ampere, double-pole, fused block is also provided.

The motor is designed especially for vehicle service and the amature mounted on annular ball bearings. It takes 36 amperes

Fig. 2.—Hunt End-dumping Electric Truck.

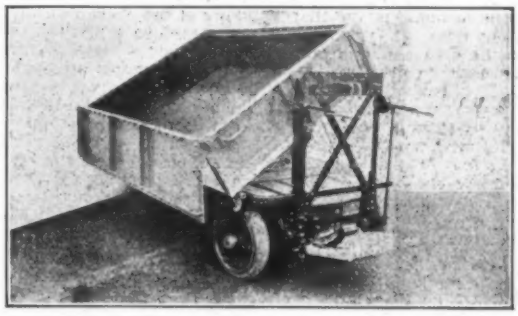


Fig. 3.—Hunt Side-dumping Electric Truck.

at 36 volts at a speed of 1,000 r.p.m., and it will take 120 amperes at 36 volts for ten minutes without overheating. This high overload capacity provides high starting power and permits the truck to handle full load on fairly heavy grades. The controller is of the drum type, having three speeds forward and three reverse with positive stop between. No resistance is used in the system of control, varying voltage being obtained by multiple series grouping of the cells, thus all of the energy delivered by the batteries is utilised through the motor, and none is wasted in useless heating up of resistances. The speed of the truck light is 6.5 m.p.h., and the safe load is 4,000 lb.

The Record Ohmmeter.

The Record Electrical Co., Ltd., of Broadheath, Altrincham, Cheshire, have just placed on the market a noteworthy addition to their range of instruments in the shape of a portable combined ohmmeter and generator for insulation testing. The total weight of the apparatus is under 12 lb., and it measures about 9½ in. × 4¼ in. × 7 in.; the carrying strap is of a novel pattern, serving the two-fold purpose of a shoulder strap and a carrying handle, the excess length of strap in the latter case being coiled up by means of a simple device. The case is of polished walnut, with rubber feet; the dial is protected with a strong hinged metal cover, and the handle is of an improved type which can be turned to lie flat against the side of the case. Interchangeability is an essential feature of the whole instrument; the generator can readily be removed *en bloc*, without breaking any soldered connections; the resistance frame is also complete in itself, and can be replaced in a few minutes. The generator, which consists largely of standardised components, is provided with ball bearings, and gives 500 volts at a handle speed of 80 r.p.m.; the collector is of simple and reliable construction, and high insulation is maintained throughout without the use of porcelain or other fragile materials. The ohmmeter has a patented moving-coil movement, free from complicated parts, and being a true ohmmeter—not merely a voltmeter calibrated in ohms—gives correct indications irrespective of the speed of the generator, the movement being also dead-beat; the scale, which is shown in fig. 4, p. 480, reads from zero to "infinity," with clear

readings from 10,000 ohms to 100 megohms. In order to produce the instrument at a low price, no complications, such as multiple ranges, &c., have been introduced into the design, the standard instrument being manufactured in mass production of one size and pattern. The appearance of the

Fig. 4.—Scale of Record Ohmmeter.

Fig. 5.—The Record Ohmmeter.

instrument is illustrated in fig. 5, which shows the special strap and handle. The terminals are fixed on the opposite end of the case. The company is to be congratulated on producing a handsome and efficient instrument, which should prove very useful to contractors and others concerned with insulation testing.

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

23,223. "Vacuum tubes." S. Brydon. September 22nd.
23,260. "Secondary generator." S. Potter. September 22nd.
23,270. "Electrically-driven talking machines." J. S. Bradshaw. September 22nd.
23,274. "Electrical indicating number switch." F. G. Pfister and A. Phillips. September 22nd.
23,275. "Variable inductances for wireless telegraphy, &c." C. C. Redshaw. September 22nd
23,279. "Electric sirens, &c., for automobiles." F. W. Berwick & Co. and M. H. L. Sizaire. September 22nd.
23,288. "Sparking plugs." P. E. Trigg. September 22nd.
23,292. "Welding machines." British Thomson-Houston Co. (General Electric Co.) September 22nd.
23,312. "Sparking plugs." T. Antoine. September 22nd.
23,313. "Wireless telegraph receivers." E. W. B. Gill. September 22nd.
23,314. "Ignition systems for internal-combustion engines." British Lighting and Ignition Co. and E. O. Turner. September 22nd.
23,324. "Improving current-carrying capacity of existing three-phase systems." A. M. Taylor. September 23rd.
23,345. "Electric telegraph sending-key." F. J. Matson and W. H. Roberts. September 23rd.
23,349. "Sparking plugs for motor bicycles." R. T. Goodyear. September 23rd.
23,377. "Electric cut-outs." J. Y. Fletcher and H. N. Green. September 23rd.
23,396. "Protective fuses for electric circuits." F. W. Uren. September 23rd.
23,406. "Telegraphic or telephonic recorders, relays, &c." J. H. Smart and J. Tucker. September 23rd.
23,425. "Electrical indicators, &c." F. R. Horley and J. G. Hooper. September 23rd.
23,440. "Trolley-heads for electric tramcars, &c." S. K. Kirkland and H. R. Tidswell. September 24th.
23,450. "Electric generating plants." Austin Motor Co. and C. B. Walker. September 24th.
23,470. "Electric lampholders, &c." D. Assersohn. September 24th.
23,495. "Electric heating stove or fire." C. O. Bastian. September 24th.
23,496. "Minimum current indicator." T. Powell. September 24th.
23,510. "Aerial systems of wireless signalling." C. S. Franklin. September 24th.
23,522. "Electrical propulsion of ships." Akt. Ges. Brown Boveri et Cie. September 24th. (Switzerland, October 1st, 1918.)
23,540. "Electric relays." S. G. Brown. September 24th.
23,576. "Telephonic, &c., transmission systems." Western Electric Co. (Western Electric Co.) September 25th.
23,578. "Insulators for overhead telegraph and telephone line wires, &c." E. A. Chantler. September 25th.
23,586. "Electric fuses." F. A. Ross. September 25th.
23,587. "Electrical heating apparatus." M. A. V. London September 25th.
23,590. "Holders for incandescent electric lamps." Fuller's United Electric Works and W. S. Gilbert. September 25th.
23,599. "Electric lamp for vehicles." P. O. Dorer and S. Smith & Sons. September 25th.
23,613. "Electrical systems of power transmission." British Thomson-Houston Co. (General Electric Co.) September 25th.
23,616. "Variable-limit switch for breaking circuit of electric motor operating printing machinery." H. V. James. September 25th.
23,623. "Electro-magnetic oscillators." W. J. Mellersh-Jackson. (Submarine Signal Co.) September 25th.
23,629. "Electric ignition devices for automobiles, &c." F. W. Berwick & Co. and M. H. L. Sizaire. September 25th.
23,637. "Means for detecting use of incandescent electric lamps." A. Pohle. December 25th. (Germany, August 28th, 1918.)
23,639. "Magneto-electric machines." F. L. Hollister. September 25th.
23,659. "Ceiling, &c., roses for electric light and power installations." J. B. Tannahill. September 25th.
23,663. "Method of alternating electrical conductivity of metals." F. H. Loring. September 25th.
23,671. "Sparking plug." A. R. Bellinger. September 26th.
23,673. "Safety switch retaining pillar." A. Gibbs. September 26th.
23,675. "Obtaining currents of any frequency from three-phase systems of any other or the same frequency." A. M. Taylor. September 26th.
23,676. "Improving power factor of alternating-current apparatus." A. M. Taylor. September 26th.
23,700. "Improving distribution on single-phase and two-phase alternating-current systems." A. M. Taylor. September 26th.
23,705. "Electric automatic gas lighter and extinguisher." R. Pellery. September 26th.
23,722. "Incandescent electric lamps." L. A. de Becker. September 26th.
23,724. "Distribution in alternating-current systems." A. M. Taylor. September 26th.
23,733. "Combination tools, &c., including sparking-plug testers." J. Hanman. September 26th.
23,750. "Bi-polar electrode electrolysers." G. G. Hepburn and Mather & Platt. September 26th.
23,752. "High-frequency alternators." British Thomson-Houston Co. (General Electric Co.) September 26th.
23,786. "Sparking plug." E. B. Morgan. September 27th.
23,791. "Socket for electric light globes." J. A. Sargent. September 27th.
23,800. "Ignition devices for internal-combustion engines." G. Constantinesco. September 27th.
23,801. "Wireless telegraphy, wireless telephony, &c." S. Brydon and A. G. T. Cusins. September 27th.

PUBLISHED SPECIFICATIONS.

The numbers in parenthesis are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

7,314. Double-current dynamos for wireless installations. R. Bosch Akt. Ges. June 1st, 1917 (117,443.)
10,714. Direction-finders and the like for wireless signalling. R. E. Vaughan. June 28th, 1918. (131,963.)
13,368. Treatment of zinc solutions preparatory to the recovery of zinc by electro-deposition. Electrolytic Zinc Co., of Australasia Proprietary. August 17th, 1917. (131,998.)
14,184. Variable-speed alternating current motors. J. D. Lewis. August 31st, 1918. (132,016.)
14,213. Electric arc lamps. H. H. Wrench and W. Engelke. September 2nd, 1918. (132,019.)
14,221. Electrical switchgear. A. Reyrolle & Co., R. W. Gregory and C. W. Clothier. September 2nd, 1918. (132,020.)
14,223. Alternating-current relays. C. V. Drysdale. September 2nd, 1918. (132,021.)
14,228. Method of and means for determining the electrical characteristics of high-frequency oscillation circuits. N. P. Hinton. September 2nd, 1918. (132,022.)
14,475. Sparking-plugs for electrical ignition systems. W. A. Jones September 6th, 1918. (132,041.)
14,987. Power modulators for radio transmission. Western Electric Co. (Western Electric Co.) September 14th, 1918. (132,058.)
15,129. Refillable electric cartridge fuses. O. H. Jung. September 17th, 1918. (132,064.)
15,542. Electric resistance furnaces for heating gases. J. Simon and P. F Sarron. September 24th, 1918. (132,080.)
15,548. Electric furnaces. T. H. Watson & Co., H. A. Greaves and H. Etchells. September 25th, 1918. (132,081.)
17,054. Radio telegraphy and telephony. M. Latour. October 18th, 1917. (132,101.)
17,962. Galvanic cells. M. L. Kaplan. November 2nd, 1918. (132,113.)
17,972. Galvanic cells. M. L. Kaplan. November 2nd, 1918. (132,114.)
18,013. Removable electric fuse carriers. W. T. Henley's Telegraph Works Co. and W. H. Nichols. November 4th, 1918. (132,115.)
18,025. Magneto-electric ignition machines. Scintilla (firm of). November 2nd, 1917. (120,897.)
18,259. Radio-telephonic apparatus. M. Latour. November 30th, 1916. (Divided application on 18,621/17.) (132,118.)
20,109. Electric relays. G. McAlpine. December 4th, 1918. (132,131.)
20,267. Ignition systems. Dayton Engineering Laboratories Co. December 15th, 1917. (121,602.)
21,812. Electric incandescent lamps. F. Lewis. December 30th, 1918. (132,145.)

1919.

466. Electric batteries. J. Y. Johnson. (Commercial Truck Co.) January 7th, 1919. (131,817.)
2,833. Dynamo-electric machines. W. G. Ivamy. February 5th, 1919. (131,825.)
2,916. Electric storage batteries or electric accumulators. Fuller Accumulator Co. and T. Jones. February 6th, 1919. (131,826.)
3,039. Method of and apparatus for continuously interrupting electrical circuits. E. C. R. Marks. (Splitdorf Electrical Co. February 7th, 1919. (132,167.)
3,161. Telephone systems. Siemens Bros. & Co. and E. A. Laidlaw. February 8th, 1919. (132,170.)
3,619. Thermic telephones or like electrical apparatus provided with heating conductors. Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. February 15th, 1918. (123,727.)
4,153. Electrical switches. Vickers, Ltd., J. Etchells and C. H. Stedman, March 2nd, 1918. (Divided application on 3,721/18.) (132,174.)
5,263. Thermal electric switches. F. W. Bundy and H. Bey. March 3rd, 1919. (131,839.)
7,831. Telephone systems. Telephone systems. Siemens Bros. & Co. and T. Pettigrew. March 28th, 1919. (132,196.)
8,179. Utilisation of high-frequency alternators in telephony. Soc. Francaise Radio Electrique. October 26th, 1917. (Divided application on 17,513/18.) (125,373.)
10,193. Carbon holder and feeding mechanism for arc lamps, particularly for use with kinematograph projectors. A. W. Newland. April 23rd, 1919. (131,856.)
10,603. Electric apparatus for indicating and repeating movements at a distance. Schneider et Cie. April 29th, 1919. (Addition to 10,676/18.) (132,203.)
12,158. Protective apparatus for dynamo-electric machines. British Westinghouse Electric and Manufacturing Co. June 29th, 1918. (Addition to 120,911.) ((129,261.)
13,175. Electric cable junction boxes or like arrangements. Siemens Bros. & Co. and H. G. Wood. May 26th, 1919. (132,216.)